THE

AMERICAN NATURALIST.

Vol. xi. — FEBRUARY, 1877. — No. 2.

SOME ACCOUNT OF THE NATURAL HISTORY OF THE FANNING GROUP OF ISLANDS.

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THE collection of islands which we have here designated by the name of Fanning's Group consists of four coral islands situated in the Pacific Ocean, immediately north of the equator. I am not aware that they have ever been grouped on any chart, but, inasmuch as they form a natural group, and as three of them were discovered by Captain Edmund Fanning, an American sailor, I think we are justified in describing them under the above title. They stretch from latitude 1° 57′ N. to 5° 49′ N., and from longitude 157° 27′ W. to 162° 11′ W., and, like most other groups in the Pacific, their general direction is northwest and southeast, thereby conforming to the general trend of the submarine range of mountains whose peaks they cap. As their formation is purely coral, their geological structure is comparatively simple.

The most westward, and evidently the last formed of the group, is Palmyra. Caldew Reef, forty miles to the northward of Palmyra, has hardly, as yet, assumed the distinctive features of an island. It is entirely under water at high tide, and but a few coral heads project here and there above the surface at low water. In the course of time, however, it will undoubtedly be added to the group. Palmyra represents the second stage in the formation of a coral island. The winds, waves, and currents, assisted probably by some other agents, have been at work on the surface coral, and have ground it and piled it up beyond the reach of the highest tides. It now consists of fifty-eight small islets, thickly clothed with vegetation, arranged in the form of an elongated horseshoe opened to the westward, and inclosing four lagoons. The islets are separated one from another by nar-

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row, shallow channels, through which the water of the ocean finds free access to the lagoons. In a completed atoll the rim of land inclosing the lagoon is unbroken, but in the greater number of coral islands a narrow lagoon-outlet is always found on the western side.

A broad, interior shore platform of fine coral sand extends, in places, from one side of the island to the other, and forms distinct boundaries for the lagoons, and connects together most of the islets. It also forms a barrier to the westward, approximating the two extremities of the horseshoe, leaving the lagoon-outlets so very narrow and shallow as hardly to admit of the passage of a ship's boat. The outer shore platform is about three hundred feet wide, and is covered with coarse coral blocks.

The island is being gradually extended to the westward. From the two ends of the horseshoe the water breaks out for a mile or more, and from the northern end it shoals around in a curve to the southward for three or four miles. This, too, in years to come, will be elevated above the surface and another body of water will be inclosed, forming a lagoon where vessels now ride at anchor.

Very scanty evidence of any agents having been at work in building up the land other than the coral animal and the action of the waves are observable anywhere about the island. The highest point is only seven feet above high water. In no place has the reef-rock been upheaved. But an elevation of a few inches might be supposed from the position of the rock of beach formation, which in places has been lifted up horizontally out of the reach of the tides.

The eastern islets are the oldest in formation. That this is true is evident from several facts. In the first place, the vegetation there is denser and ranker, and more genera are represented than on the islets to the leeward. All the plants that were found growing on the latter islets also exist on the eastern, with the addition of several species that have not yet been diffused to the westward, showing that the germs of life started into existence in the east, the direction of the prevailing wind and current. A further proof of this is shown in the condition of the cocoanut-trees in the different localities. This tree when young is bulbous at the base, a condition which is observable in all the trees on the western islets, while on those to the windward they are taller and the trunks have nearly the same diameter from the base to the crown.

Washington Island, the most remarkable of the group, presents several very interesting geological features. The evidences of the operation of some great disturbing agent are more plainly visible here than elsewhere. Either this force must have been extremely local in its operation, or else it was exerted upon the member of the group which we have just considered when it was in such a condition as not to show it. The latter hypothesis is the most reasonable. Washington Island is an obliterated atoll. In the place of the usual salt water lagoon there is a lake of fresh water, one mile long and half a mile wide, with a depth of four fathoms in its deepest part. No shore platform makes out from the land at low water, but the sea at all stages of the tide breaks directly on the beach, except at the angles of the island where reefs extend a certain distance into the sea. The beach shelves rather abruptly to the water's edge. The highest part of the land is about fifteen feet high, and over all the interior of the island there are outcroppings of the reef-rock and the rock of beach formation. All traces of the former passage from the sea into the lagoon have been obliterated. The salt water of the lagoon has either drained off through the light, porous soil, or has been freshened by the immense rain-falls which occur in these latitudes. The latter event is not improbable, considering the situation of the island on the edge of the trades, in the region of variable winds, where rains are frequent and heavy.

In time past, the rim of land inclosed three lagoons. One, the largest, is now the lake; the others are about half the size of the first, and are converted into peat-bogs. The latter are thickly overgrown with rushes and contain a solid deposit of vegetable matter three or four feet deep, composed of the roots, trunks, and *débris* of the cocoanut and pandanus trees closely matted by the roots of the rushes. The time of our visit was just after a heavy rain, and a layer of water from six to eighteen inches deep covered the surface of the bogs.

The island supports a dense and luxuriant growth of vegetation, and a greater number of species are represented there than on any of the other islands of the group.

The water of the lake is just perceptibly brackish; and the only life it is said to contain are a species of eel and a shrimp, both of which we were told are different from anything found in the water surrounding the island. This information was derived from an intelligent Englishman, who had visited the island several times to superintend the gathering of the cocoanuts. They

are the kinds of life that we should look upon as being the first to adapt themselves to the altered condition of things. Unfortunately we were not able to procure a specimen of either. Our stay was so limited (but a part of one day was spent there), that we could not make as thorough an examination of the island as its interesting nature called for.

The richest results obtained in our brief visit were in the department of ornithology. The lake and peat-bogs were tenanted by a diminutive species of duck of the genus *Chaulelasmus*. *C. Couesi* we have named it, in honor of Dr. Elliot Coues. (Bull. Nuttall Orn. Club, vol. i. p. 46, 1876.) This is the second species of the genus known to exist. The other, *C. streperus*, the common gadwall, is almost cosmopolitan; the one is as restricted in its habitat as the other is wide-spread. The markings on the plumage of the two species are almost identical; they differ only in size, and in some minor details of bill and feet.

By far the handsomest of all the feathered tribe of the island is a little lory, the *Coriphilus kuhli*. It belongs to the Polynesian group of parrots, which are distinguished by the predominance of red in their plumage. Though not new to science, yet its discovery, or rather re-discovery, was an important event as determining its habitat. Finsch in his "Papagien" has the following concerning it: "This is one of the rarest parrots existing, only to be found in few museums. It was erroneously said by Wagler to come from the Sandwich Islands. Latterly this rare species does not seem to come to Europe at all, which is surprising, inasmuch as the Society Islands, which thus far have been regarded as their only home, have considerable traffic with Europe. As a special locality, Vigors mentions Tubuititiruba, near Tahiti: Lesson gives Borabora. Bourjot's specimen in the Paris Museum is said to have come from Fanning Island, northwest of Christmas, and northeast of the Phœnix group. But although everything is diametrically opposed to this assertion, it might nevertheless not be improbable that this very island is its true home." Fanning Island is one of this group, and is situated about seventy miles south of Washington Island. These two islands are without doubt the true habitat of this lory, and it is highly improbable that it ever came from any other locality.

The following untechnical description, which is copied from Fanning's Voyages, is sufficient to prove that *C. kuhli* inhabited Fanning's Island at the time of its discovery in 1798. "Amongst

the birds was one species about the size of our robin, with a breast of scarlet colored feathers, the under portion of the body being finished off with bright red, the neck of a golden color, back of a lively green, with a yellow beak, except the very points, which were of a bright dun color, the wings and tail being both of a jet black, and the last tipped off with white; it was a most beautiful and lovely bird with its brilliant and richly variegated plumage."

They were reasonably abundant on Washington Island, and when I signified a desire to a native of the Kingsmill group to have some of the birds alive, he gratified me in the following manner: He took two pieces of bamboo, each about a yard long. On the end of one he perched a tame bird, and from the extremity of the other suspended a running noose. The tame bird, as it was carried about among the cocoanut-trees, uttered a harsh, rasping sound, and wild birds came out of the trees and perched alongside it on the bamboo, when, by means of the other stick, they were carefully noosed.

When caged aboard the ship, they exhibited as pretty a picture of love as one can imagine, well meriting their name of "love-birds." They sat billing and smoothing each other's feathers for hours, and as night came on two would get together, and sleep with their heads turned towards each other. They lived in confinement but a very short time, and bore it badly. Even while we stood watching their lively antics one would tumble off its perch and die, apparently in convulsions.

The only other land bird found on Washington Island belonged to the *Passeres*. It was a flycatcher-like bird. As many of these as were seen were procured, but the specimens were sent home from the Pacific, and before I arrived east to commence the work of identification, they were distributed through the general collection of the Smithsonian Institution and have not yet been found. This is to be deplored, for they would probably be as interesting as the other species obtained from the same locality. A bird similar to these, but smaller and somewhat browner — which I think can be accounted for by the altered conditions of its surroundings — was found on Christmas Island, where it was the only land bird. But this, like the previous species, is mislaid in the collection at Washington.

Christmas Island was discovered by the great English navigator, Cook, and it has been visited a number of times by exploring expeditions. It is therefore not such a *terra incognita* as the ones we have been considering.

It is the largest island of the group, and is situated the furthest to the eastward and southward, in close proximity to the equator. It consists of a narrow rim of land, thirty miles in circumference, inclosing an immense lagoon. All of our research was limited to the western side.

There are unmistakable evidences of an elevation beyond the height to which land can be built up by the waves and tides. North of the lagoon entrance a distinct old beach line could be traced running parallel to an ancient shore ridge, and distant about two hundred yards from the water of the present lagoon. The shore ridge, about twelve feet high, runs north and south, and is about one hundred yards from the sea-beach. Between the ridge and the beach the surface is thickly strewn with coarse coral blocks of the old shore platform. At the time when the sea washed over this platform it was separated from the water in the lagoon only by the breadth of the shore ridge. A tract of land, from two to three hundred yards in width, has been added to the island by upheaval. The massive reef-rock is elevated all along the present shore line. The highest land is from fifteen to twenty feet high.

This island is far removed from the others in its local conditions; there is no fresh water, it rarely or never rains, the vegetation is low and scanty, — the densest of it hardly casting a shadow, — and the white coral sand glows with the direct rays of the sun's heat. It was interesting to note the changed habits of the birds under these altered surroundings. In December, on Palmyra, the gannet (*Sula piscator*) had finished the period of its incubation, and the young were large-sized; on Christmas Island, one month later, we found the same species still sitting on their eggs, and few or no young were seen. These birds were observed to have a very curious habit in the latter locality, which they were not seen to possess on Palmyra. They constructed their nests on the low shrubbery, and under each nest was a mound, two or three feet tall, composed of twigs, and solidly cemented together by their excrement. They evidently occupy the same nest for several successive seasons, — for the lean bushes would hardly furnish a sufficient quantity of twigs to build up the mounds in a single season — and it may be they amuse themselves, while sitting on their eggs, by breaking off all the small branches within reach of their beaks and dropping them under their nests.

The other birds are equally backward in the performance of their marital duties. On Palmyra the *Gygis alba* and the noddy

(*Anous stolidus*) lay their eggs; the former on the naked branches of the trees, which in some instances are hardly greater in diameter than the egg itself, and the latter in well constructed nests of twigs in the forks of the branches of the tall trees. On Christmas Island the larger coral blocks answer the purpose of the first named, and a shallow concavity scooped in the bare ground that of the last.

Most birds are guided by their instinct of self-preservation in selecting a site for the construction of their nests; in fact, I may say this seems to be a law. But in this case there is nothing on the one island, not found on the other, which would drive them to adopt these widely different habits. It is evident that they simply conform to their surroundings. The ground and coral blocks are both present on Palmyra, yet they choose the trees in preference, being guided probably by their taste rather than by a desire for protection.

The sooty terns (*Sterna fuliginosa*) were breeding on Palmyra. Their chosen locality is the extreme eastern point of the island, on the bare clinker beach, almost within reach of the breakers. They make no attempt to construct a nest; nor do they so much as scoop a hole in the ground to receive their eggs, which are dropped apparently anywhere. They live as a community by themselves during the breeding season, and so great are their numbers that they form a cloud when driven from the ground, and their clamor deadens the roar of the surf.

The *Sula cyanops* was breeding on Christmas Island. A few of the same species, all in immature plumage, were nesting on Palmyra. The old and the young were in no instance found nesting together on the same breeding ground; the former were confined to Christmas, and the latter to Palmyra Island. Is it possible that the young individuals are ostracized until they robe themselves in the fashionable dress?

The only other birds found breeding on Christmas Island were the red-tailed tropic-bird (*Phæthon rubricauda*), the *Æstrelata parvirostris*, and a new species of puffin (*Puffinus*), not yet described. The bristly-thigh curlew (*Numenius femoralis*), the golden-back plover (*Charadrius fulvus*), the *Totanus semipalmatus*, and a species of *Tringa* were common to both islands, but were more numerous on Palmyra. The same statement may be applied to the lesser frigate bird (*Tachypetes Palmerstoni*).

These birds constitute the whole avifauna, and are almost the

only life of the islands. The sea-birds range away from the land, in pursuit of their finny prey, to a distance varying from sixty to eighty and sometimes even to a hundred miles; and so unerring are they in their return to their breeding and roosting places, that we were told the captains of the small schooners, who seek the islands to harvest their crop of cocoanuts and to look about for guano, find the objects of their search by laying to, when they imagine themselves somewhere in their vicinity, until evening, when the birds wing their way homeward, and then shaping their course by the direction of the flight of the birds.

The other terrestrial animals of Palmyra are a minute shell, a *Tornatellina*, that clings to the under surface of the fronds of the *Polypodium aureum*, and a land leech that fastens itself to the eyelids of the young birds.

A soldier-crab (*Cœnobita Glivieri*) quits the water and lives on the land at certain seasons of the year, and it may therefore be properly considered terrestrial. They are ubiquitous; they climb the trees and bushes, dragging after them the heavy shells of the *Turbo argyrostoma*.

Washington Island is a home of the gigantic *Burgus latro*. "In the Pacific this species, or one with closely allied habits, is said to inhabit a single coral island north of the Society group." Since this statement of Darwin's was made, we have gained a much better knowledge of its distribution, so that now it may be said there is scarcely a group of islands in the Pacific Ocean where it is not found. The stories about this crab climbing trees after cocoanuts are entirely unfounded. It lives in burrows in the ground, and feeds on the cocoanuts as they fall from the trees. It first strips off the husk, shred by shred, and then, with its strong pincers, breaks through the shell at the extremity that holds the eyes. The strength of their claws is sufficient to crush a lath in twain, and so tenaciously do they hold on to anything when once they have obtained a grip, that I have known them to hang suspended from a tree for an hour or more, holding on by their claws. Sometimes the unwary native, in searching their burrows with his hand for the fine cocoanut husk which forms their bed, is surprised to find his fingers in the vice-like grasp of the crab; and it may be interesting to know that in such a dilemma a gentle titillation of the under soft parts of the body with any light material will cause the crab to loose his hold. They are said to visit the sea at night for the purpose of wetting their branchiæ.

EXPLORATIONS MADE IN COLORADO UNDER THE DIRECTION OF PROF. F. V. HAYDEN IN 1876.

FOR reasons beyond the control of the geologist-in-charge, the various parties composing the United States Geological and Geographical Survey of the Territories did not commence their field work until August. Owing to the evidences of hostility among the northern tribes of Indians, it was deemed most prudent to confine the labors of the survey to the completion of the atlas of Colorado. Therefore the work of the season of 1876 was a continuation of the labors of the three preceding years, westward, finishing the entire mountainous portion of Colorado with a belt fifteen miles in width of Northern New Mexico and a belt twenty-five miles in breadth of Eastern Utah. Six sheets of the physical atlas are now nearly ready to be issued from the press. Each sheet embraces an area of over 11,500 square miles or a total of 70,000 square miles. The maps are constructed on a scale of four miles to one inch with contours of two hundred feet which will form the basis on which will be represented the geology, mineral, grass, and timber lands, and all lands that can be rendered available for agriculture by irrigation. The areas of exploration are located in the interior of the continent, far remote from settlements, and among the hostile bands of Ute Indians that attacked two of the parties the previous year.

The point of departure the past season was Cheyenne, Wyoming Territory. The primary triangulation party was placed in charge of A. D. Wilson, and took the field from Trinidad, the southern terminus of the Denver and Rio Grande Railway, August 18th, making the first station on Fisher's Peak. From this point the party marched up the valley of the Purgatoire, crossed the Sangre de Cristo Range by way of Costilla Pass, followed the west base of the range northward as far as Fort Garland, making a station on Culebra Peak.

About six miles north of Fort Garland is located one of the highest and most rugged mountain peaks in the West, called Blanca Peak, the principal summit of the Sierra Blanca Group. On the morning of August 28th the party, with a pack mule to transport the large theodolite, followed up a long spur which juts out to the south. They found no difficulty in riding to the timber line, which is here about twelve thousand feet above the sea-level. At this point they were compelled to leave the animals, and, distributing the instruments among the different

members of the party, proceeded on foot up the loose rocky slope to the first outstanding point, from which a view could be obtained of the main peak of the range. Although this first point is only six hundred feet lower than the main summit, yet the most arduous portion of the task was yet to come. The main summit is about two miles north of the first point, in a straight line, and connected with it by a very sharp-toothed zigzag ridge over which it is most difficult to travel on account of the very loose rocks and the constant danger of being precipitated down, on either side, several hundred feet into the amphitheatre below. After some two hours of this difficult climbing, they came to the base of the main point, which though very steep was soon ascended, and at eleven o'clock, A. M. they found themselves on the very summit. From this point one of the most magnificent views in all Colorado was spread out before them. The greater portion of Colorado and New Mexico was embraced in this field of vision. This point is the highest in the Sierra Blanca group and so far as is known at the present time is the highest in Colorado. The elevation of this point was determined by Mr. Wilson in the following manner: first, by a mean of eight barometric readings taken synchronously with those at Fort Garland, which gave a difference between the two points of 6466 feet; secondly, by fore and back angles of elevation and depression, which gave a difference of 6468 feet. The elevation at the fort was determined by a series of barometric readings, which compared with those of the signal-service barometer at Colorado Springs gave it an elevation of 7997 feet, making the Blanca Peak 14,464 feet above sea-level. This peak may be regarded therefore as the highest or at least next to the highest yet known in the United States. A comparison with some of the first-class peaks in Colorado will show the relative height: —

	Above sea-level.
Blanca Peak	14,464 feet.
Mt. Harvard	14,384 "
Gray's Peak	14,341 "
Mt. Lincoln	14,296 "
Mt. Wilson	14,280 "
Long's Peak	14,271 "
Uncompahgre Peak	14,235 "
Pike's Peak	14,146 "

The foregoing table will afford some conception of the difficulty encountered in determining the highest peak when there are so many that are of nearly the same elevation. About fifty peaks are found within the limits of Colorado that exceed fourteen thousand feet above sea-level.

From this point the party proceeded westward across the San Luis valley and up the Rio Grande to its source, making two primary stations on the way, one near the summit district and the other on the Rio Grande Pyramid. From the head of the Rio Grande the party crossed the continental divide, striking the Animas Park, thence west by trail to Parrott City.

After making a station on La Plata Peak, the party marched northwest across the broken mesa country west of the Dolores, making three stations on the route to complete a small piece of topography that had been omitted the previous year on account of the hostility of the Ute Indians. After making a primary station on the highest point of the Abajo Mountains, the party turned westward to Lone Cone, where another station was made; thence, crossing the Gunnison and Grand rivers, they proceeded to the great volcanic plateau at the head of White River. The final station was made between the White and Yampah rivers in the northwestern corner of Colorado. During this brief season, Mr. Wilson finished about one thousand square miles of topography and made eleven geodetic stations, thus connecting together by a system of primary triangles the whole of Southern and Western Colorado.

In company with the triangulation party, Mr. Holmes made a hurried trip through Colorado, touching also portions of New Mexico and Utah. He was unable to pay much attention to detailed work, but had an excellent opportunity of taking a general view of the two great plain-belts that lie, the one along the eastern, the other along the western base of the Rocky Mountains. For nearly two thousand miles of travel he had constantly in view the Cretaceous and Tertiary formations, with which are involved some of the most interesting geological questions. He observed among other things the great persistency of the various groups of rocks throughout the east, west, and north, and especially in the west, for from Northern New Mexico to Southern Wyoming the various members of the Cretaceous formation lie in almost unbroken belts, while the Tertiaries are hardly less easily followed.

Between the east and the west there is only one great incongruity. Along the eastern base of the mountains the upper Cretaceous rocks, including numbers four and five, are almost wanting, consisting at most of a few hundred feet of shales and laminated sandstones. Along the western base this group becomes a prominent and important topographical as well as geological feature.

In the southwest, where it forms the "mesa verde" and the cap of the Dolores plateau, it comprises upwards of two thousand feet of coal-bearing strata, chiefly sandstone, while in the north it reaches a thickness of 3500 feet and forms the gigantic hog-back of the Grand River Valley.

While in the southwest he visited the Sierra Abajo, a small group of mountains which lie in Eastern Utah, and found, as he had previously surmised, that the structure was identical with that of the other four isolated groups that lie in the same region. A mass of trachyte has been forced up through fissures in the sedimentary rocks and now rests chiefly upon the sandstones and shales of the lower Cretaceous. There is a considerable amount of arching of the sedimentary rocks, probably caused by the intrusion of wedge-like sheets of trachyte, while the broken edges of the beds are frequently bent abruptly as if by the upward or lateral pressure of the rising mass. He was able to make many additional observations on the geology of the San Juan region and secured much valuable material for the coloring of the final map.

He states that the northern limit of ancient cliff builders in Colorado and Eastern Utah is hardly above latitude 37° 45′.

The Grand River Division was directed by Henry Gannett, topographer, with Dr. A. C. Peale as geologist. James Stevenson, executive officer of the survey, accompanied this division for the purpose of assisting in the management of the Indians, who last year prevented the completion of the work in this locality by their hostility.

The work assigned this division consisted in part of a small area, containing about one thousand square miles, lying south of the Sierra la Sal. The greater portion of the work of this division lay north of the Grand River, limited on the north by the parallel of 39° 30′ and included between the meridians of 108° and 109° 30′.

This division took the field at Cañon City, Colorado, about the middle of August. The party traveled nearly west, up the Arkansas River, over Marshall's Pass and down the Pomichi and Gunnison rivers to the Uncompahgre (Ute) Indian agency. Here they secured the services of several Indians as escort in the somewhat dangerous country which they were first to survey. This area lying south of the Sierra la Sal was worked without difficulty. It is a broken plateau country and presents many curious pieces of topography. Eleven days were occupied in this work.

The Grand River from the mouth of the Gunnison River to that of the Dolores, that is, for nearly a hundred miles, flows along the southern edge of a broad valley, much of the way being in a low cañon, one hundred to two hundred feet deep. The course of the river is first northwest for twenty-five miles, then turning abruptly it flows southwest, and then south for about seventy-five miles. This valley has an average width of twelve miles. It is limited on the north and west by the Roan or Book Cliffs and their foot-hills, which follow the general course of the river. These cliffs rise from the valley in a succession of steps to a height of about four thousand feet above it, or eight thousand to eighty-five hundred above the sea.

From its crest, this plateau (for the Book Cliffs are but the southern escarpment of a plateau) slopes to the north-northeast at an angle of not more than 5°. It extends from the Wahsatch Mountains on the west, to the foot-hills of the Park Range on the east, and presents everywhere the same characteristics. The Green River crosses it, flowing in a direction exactly the reverse of the dip. It borders the Grand on the north for one hundred and fifty miles, the crest forming the divide between the Grand and the White. On the south side of the crest are broken cliffs; on the north side, the branches of the White River immediately form cañons. This leaves the divide in many places very narrow, in some cases not more than thirty to forty feet wide, with a vertical descent on the south towards the Grand River and an extremely steep earth slope (35° in many cases) at the heads of the streams flowing north to the White River. This crest, though not over eighty-five hundred feet in height, is the highest land for a long distance in every direction.

After leaving the Uncompahgre agency, the party followed Gunnison's Salt Lake road to the Grand and down that river to the mouth of the Dolores, in latitude 38° 50′, longitude 109° 16′. At this point they turned northward and went up to the crest of the Book plateau. They followed this crest to the eastward for upwards of a hundred miles to longitude 108° 15′, then descended to the Grand and followed it up to longitude 107° 35′, and thence went, via the White River (Ute) Indian agency, to Rawlins, where they arrived on October 23d.

The whole area worked is about thirty-five hundred square miles, in surveying which about sixty stations were made. The geological work of this division by Dr. Peale connects directly with that done by him in 1874 and 1875. Sedimentary formations prevail in both districts visited during the past season.

The country first examined lies between the San Miguel and Dolores rivers, extending northward and northwestward from Lone Cone Mountain. The general character of this region is that of a plateau cut by deep gorges or cañons, some of which, especially towards the north, extend from the sandstones of the Dakota Group to the top of the red beds. The depth of the cañons, however, is no indication of their importance as stream beds, for away from the main streams they are dry the greater portion of the year. There are no great disturbances of the strata, what folds do occur, being broad and comparatively gentle.

The San Miguel River, leaving the San Juan Mountains, flows towards the northwest and with its tributaries cuts through the sandstones of the Dakota Group, exposing the variegated beds lying beneath, that have generally been referred to the Jurassic.

About twenty-five or thirty miles north of Lone Cone, the river turns abruptly to the west and flows west and southwest for about fifteen miles, when it again turns and flows generally northwest until it joins the Dolores. Between the San Miguel and Lone Cone the sandstones of the Dakota Group or number one Cretaceous are nearly horizontal, forming a plateau which on approaching the mountains has a capping of Cretaceous shales.

Beyond the bend, the San Miguel flows in a monoclinal valley in which the cañon walls are of the same description as in the upper part of its course. As the mouth is approached the red beds appear. Between this portion of the course of the San Miguel and the almost parallel course of the Dolores, which is in a similar monoclinal rift, there are two anticlinal and two synclinal valleys parallel to each other. They are all occupied by branches of the Dolores. Lower Cretaceous Jurassic and Triassic strata outcrop and present some interesting geological details which will be fully considered in the report on the district. The Dolores River comes from a high plateau in a zigzag course, flowing sometimes with the strike and sometimes with the dip of the strata. Its general course on the western line is about northwest, from which it turns to the northward and westward, finally changing to northwest again for its junction with the Grand. It is in a cañon the greater part of its course.

In the region of country north of Grand River, the geological formations extend uninterruptedly from the red beds exposed on Grand River to the white Tertiary cliffs forming the summit of the "Roan Mountains" or Book Cliffs. The Grand is generally in a cañon in the red beds.

On the north side, the number one Cretaceous sandstone forms a hog-back sloping towards the cliffs. Between the crest of this hog-back and the cliffs, there is a broad valley formed by the erosion of the soft Cretaceous shales which extend to the base of the cliffs and in some places form their lower portion.

The cliffs are composed mainly of Cretaceous beds, rising one above another in steps, until an elevation of about eight thousand feet is reached. The summit is the edge of a plateau sloping to north-northeast. This plateau is cut by the drainage flowing into the White River from the south. These streams rarely cut through the Tertiary series.

Coal of poor quality is found in the sandstones of the Dakota Group and also in the sandstones above the middle Cretaceous beds. Wherever noticed it was in thin seams and of little economic importance.

The White River division was directed by G. B. Chittenden as topographer, accompanied by Dr. F. M. Endlich as geologist. The district assigned to this party as their field for exploration during the season of 1876 commenced from the eastward at longitude 107° 30′, joining on to the work previously done, and extended westward thirty miles into Utah Territory. Its southern boundary was north latitude 39° 30′, while the White River formed the northern limit. In order to complete the work to the greatest possible advantage in the shortest time that could be allowed, it was determined to make the White River agency the headquarters, and in two trips from there finish the work. About thirty-eight thousand square miles comprised the area surveyed.

In working up the topography of the district, the party spent forty-eight days of absolute field work, made forty-one main topographical stations and sixteen auxiliary ones, and traveled within the district about one thousand miles. The party ascertained the course of all the main trails, the location and quality of all the water, which is scanty throughout, and can map with considerable accuracy the topographical forms and all the watercourses. The area is almost entirely devoid of topographical "points" and the topographer is obliged to depend to a considerable degree on those far to the north and south for the triangulation. The country has been heretofore almost entirely unexplored, and was described by the nearest settlers as a broken cañon country, extremely dry. It was marked on the maps as a high undulating plateau, with fresh-water lakes and timber.

The party saw no lakes of more than four hundred yards in diameter and only two or three of those. The country is nearly all inhabitable both winter and summer, and considerable portions of it are valuable, and though three quarters of it is within the Ute Indian Reservation, the advantage of a more accurate knowledge of its character can readily be seen.

While working in the low broken country of Southwestern Colorado last year, Mr. Chittenden made use of a light portable plane table and found it of great value. It appeared at that time that its value was greatest in that class of country, and that in a low rolling district with few prominent points, or in a high-mountain country, it would probably be of little or no use.

Altitudes were determined by the mercurial barometer with a base at the White River Indian agency and checked by a continuous system of vertical angles. The altitude of the agency has been determined by a series of barometric observations extending over two years and a half and referred to railroad levels, and can probably be depended on to within a few feet. The altitude of the agency being about sixty-five hundred feet, and the altitudes in the district ranging from five thousand to eight thousand feet, makes its location the best possible in height for a barometric survey of the region.

It is the intention of the survey during the coming year to publish some tabulated results of the barometric work in Colorado, showing the system and its accuracy and reliability. This may be of use in future work, since the topography of the whole West must greatly depend on barometric determinations of altitude, while Colorado has furnished almost every possible phase of western topography.

The longest dimension of the work lying east and west and the White and Grand rivers running in approximately parallel courses, the district stretched from the White River up over the divide between the Grand and White and embraced the heads of the lateral drainage of the former river.

The general topography is a gentle rise from the White River towards the south, and a sudden breaking off when the divide is reached into rugged and often impassable cliffs known on the maps as the Roan or Book Mountains. The gentle plateau slope of the White River side is cut by almost numberless and often deep cañons, and in many cases the surface of the country has been eroded, leaving broken and picturesque forms, the lower benches generally covered with cedars and piñons, and the upper rich in grass.

There are four main streams draining into the White River within the limits of our work, a distance of something over one hundred miles.

The country is almost entirely destitute of timber and has but little good water. It is, however, abundantly and richly supplied with grass, and, especially in the winter season, must be well stocked with game. It seems well adapted to its present use as an Indian reservation, and is likely to remain for years to come more valuable for them than it could be for settlement.

In the far western portion, and outside the limits of the reservation, one large vein of asphaltum and several small ones were found, and also running springs of the same material, all of which if once reached by railroads will prove of great commercial value. These deposits have been spoken of before, but their location has not been accurately determined. The principal vein seen by this party is at present about one hundred miles from railroad communication, but less than half that distance from white settlements, and is likely in the present rapid growth of the country to be within a few years made available.

According to the report of F. M. Endlich, the geology of the district is very simple, though interesting. Inasmuch as there is but one divide of importance within the district, the work was somewhat simplified. This divide is formed by the Book Cliffs and separates the drainages of the Grand on the south from that of the White on the north. Both of these rivers flow a little south of west into the Green River, which they join in Utah. From the junction of the Grand and Green downward, the river is called the Colorado. Orographically the region surveyed is comparatively simple. The Book Cliffs are the summit of a plateau, about eight thousand feet above sea-level, which continues unbroken over to the Green River. Towards the south these cliffs fall off very steeply, forming deep cañons that contain tributaries of the Grand River. On the north side, with the dip of the strata the slope is more gentle, although in consequence of erosion numerous precipitous cliffs are found. Descending in that direction the character of the country changes. Instead of an unbroken slope, we find that the plateau has been cut parallel by the White River drainage and the long characteristic mesas of that region testify to the action of erosion. Approaching the river, constantly descending with the slight dip of the strata, the bluffs become lower and lower. Though the creek valleys are wide and at certain seasons no doubt well watered, the vegetation is

that of an arid country. Dwarf pines, piñons, and sage-brush abound, to the almost entire exclusion of other trees or grass. Traveling down White River this character is again found to change. A new series of bluffs, occasioned by heavy superincumbent strata, gives rise to the formations of deep cañons. For forty-five miles the party followed the cañon of the White, which no doubt is analogous to that of the Green, and probably closely resembles that of the Colorado in its detail features. Vertical walls enclose the narrow river-bottoms and the slopes of the higher portions are ornamented by thousands of curiously eroded rocks. Monuments of all kinds and figures that can be readily compared to those of animated beings enliven the scenery, which otherwise would be very monotonous. Two thousand to three thousand feet may be stated as the height of the walls inclosing the White River. Geologically speaking, the district is one of singular uniformity. Traveling westward, the older formations, reaching back as far as the Triassic, were found. This is followed by Cretaceous, which in turn is covered by Tertiary. About three quarters of the region surveyed was found to contain beds belonging to this period. Owing to the lithographical character of the strata, water was a rare luxury in this region, and men and animals were frequently compelled to look for springs. Farther west still, the Green River Group sets in, forming those numerous cañons of which that of the White River is one.

Having completed their work by October 14th, the party marched eastward through Middle Park, and after twelve days of rain and snow reached Boulder City, Colorado.

The field work of the Yampah division during the past season was principally confined to a district of Northwestern Colorado lying between the Yampah and White rivers, and between Green River and the subordinate range of mountains that lies west of and parallel with the Park Range. The area is embraced between parallels 39° 30′ and 40° 30′ and meridians 107° 30′ and 109° 30′.

The party consisted of Mr. G. R. Bechler, topographer directing, accompanied by Dr. C. A. White, the well-known geologist. They proceeded southward from Rawlins Springs, a station on the Union Pacific Railroad, on August 6th, toward their field of labor. From Rawlins Springs to Snake River, a distance of eighty miles, table-lands form the chief feature of the topography, while from Snake River to the Yampah River the surface is

more undulating and thickly covered with sage. Between the Yampah and White rivers, a distance of fifty miles, the country is mountainous; and on the divide between the Yampah and White rivers the elevation is eight thousand to nine thousand feet. Mr. Bechler, after having formed the geodetic connection with the work of previous years, concluded to finish the more mountainous portion of the area assigned to him, which began in the longitude of the White River agency and extended westward to about 108° 10′. Here the party found water and grass in abundance, with one exception.

The plateau country, however, was so destitute of water and so cut up with dry gorges or cañons with scarcely any grass or timber of any kind, that traveling was rendered very difficult. The party therefore made White River its base of supply for water and grass, making side trips among the barren hill-tops or plateaus in every direction.

From the Ute Agency, which is located approximately in latitude 38° 58′ and longitude 107° 48′, the White River takes an almost due west course for fifteen or eighteen miles, most of the way through an open valley with here and there narrow gorges. About fifty miles from the agency, the river opens into a broad barren valley, with only here and there scanty patches of vegetation. Soon after, the river enters a deep cañon with vertical walls one thousand feet or more in height which continue to increase in depth until the river flows into the Green River.

The Yampah or Bear River occasionally deviates from a westerly course only f r a few miles. Like White River it flows through a plateau country which rises gently from the river, back for a distance of about eight miles. South of the river lie the Williams River Mountains, which have a gradual slope to the north. Williams Fork, flowing from a southeastern direction, joins the Yampah River. West of the junction, the Yampah traverses the country more or less in a cañon, occasionally emerging into an open grassy valley, then enters a deep cañon, cuts through the Yampah Mountains, when it joins with the Snake River. The place of junction resembles a fine park surrounded on all sides with eroded terraces and plateau spurs, that rise by steps to the divide on either side. This park is about eight miles in length from east to west.

After leaving this park the river enters a huge fissure in the mountains, where it remains until, completing its zigzag course, it joins the Green River in longitude 109° 40′ and latitude 32° 00′.

After the junction with the Yampah, the Green River continues in a cañon for fourteen miles where it passes through the picturesque palisades of Split Mountain into an open broad valley, longitude 109° 15′, latitude 40° 28′, from which point it takes a southeast direction through the Wamsitta Valley, where it unites with the White River.

Into both White and Yampah rivers, numerous branches extend from either side, forming deep cañons the greater portion of their length. We may say in brief, that the sides of the valleys expand and contract, at one time forming the beautiful grassy valleys which in olden times were celebrated as the favorite wintering places for the trappers, or contracting so as to form narrow cañons or gorges with walls of varied height.

The walls of Yampah Cañon average about one thousand feet, while the mountains receding back to the northward attain an elevation of forty-two hundred feet, and the highest point of the plateau on the south side is thirty-four hundred feet above the river level.

Of the plateaus between White and Yampah rivers, Yampah Plateau is the largest, and occupies an area of four hundred square miles. The surface of the summit is undulating and on the south side it presents a steep face, several hundred feet in height, covered with débris, rendering it almost inaccessible. This plateau is covered with excellent grass and gives origin to numerous springs, all of which dry up within a short distance of their source. As a whole, this district is very arid, barren, and almost entirely destitute of tree vegetation.

The total number of stations made by Mr. Bechler in the district assigned to him was forty, and the entire area about three thousand square miles. Barometric observations were made whenever needed, and about two thousand angles of elevation and depression with fore and back sights, so that the material for attaining the correct altitudes is abundant.

The rocks of this district embrace all the sedimentary formations yet recognized by the investigators who have studied the region that lies between the Park Range and the Great Salt Lake, namely, from the Weber Quartzite (which underlies the Carboniferous) to the group or latest Tertiary, inclusive. Not only has the geographical distribution of these formations been mapped, but all the displacements of the strata have been traced and delineated. The last-named investigations bring out some interesting and important facts in relation to the orographic geology of the region, especially as regards the eastern termina-

tion of the great Uinta uplift and the blending of its vanishing primary and accessary displacements with those of the north and south range above-mentioned. Much information was also obtained concerning the distribution of the local drift of that region, the extent and geological date of outflows of trap, etc.

The brackish water beds at the base of the Tertiary series, containing the characteristic fossils, were discovered in the valley of the Yampah. They are thus shown to be exactly equivalent with those, now so well known, in the valley of Bitter Creek, Wyoming Territory. These last-named localities were also visited at the close of the season's work, and from the strata of this horizon at Black Butt's Station three new species of *Unio* were obtained, making six clearly distinct species in all, that have been obtained, associated together in one stratum, at that locality. They are all of either distinctively American types or closely related to species now living in American fresh waters. They represent, by their affinities, the following living species: *Unio clavus* Lamarck; *U. securis* Lea; *U. gibbosus* Barnes; *U. metanurus* Rafinesque and *U. complanatus* Solander. They are associated in the same stratum with species of the genera *Corbula*, *Corbicula*, *Neritina*, *Viparus*, etc., this stratum alternating with layers containing *Ostrea* and *Anomia*.

The close affinity of these fossil Unios with species now living in the Mississippi River and its tributaries seems plainly suggestive of the fact that they represent the ancestry of the living ones. An interesting series of facts has also been collected, showing that some of the so-called American types of Unio were introduced in what is now the great Rocky Mountain region, as early as the Jurassic period, and that their differentiation had become great and clearly defined as early as late Cretaceous and early Tertiary times. Other observations suggest the probable lines of geographical distribution, during the late geological periods, of their evolutional descent, by one or more of which they have probably reached the Mississippi River system and culminated in the numerous and diverse forms that now exist there.

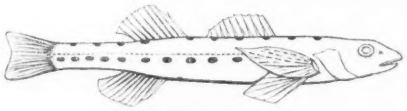
The work of the past season shows very clearly the harmonious relations of the various groups of strata over vast areas; that although there may be a thickening or a thinning out of beds at different points they can all be correlated from the Missouri River to the Sierra Nevada Basin. The fact also that there is no physical or palæontological break in these groups over large areas from the Cretaceous to the Middle Tertiary is fully established. The transition from marine to brackish-water forms

of life commences at the close of the Cretaceous epoch and without any line of separation that can yet be detected continues on upward until only purely fresh-water forms are to be found. Dr. White, an eminent palæontologist and geologist, says that the line must be drawn somewhere between the Cretaceous and Tertiary epochs, but that it will be strictly arbitrary, as there is no well marked physical break to the summit of the Bridger Group.

THE SAND DARTER.

BY D. S. JORDAN AND H. E. COPELAND.

WE have often brought home with us a "Johnny," "Speck," or "Crawl-a-bottom," of a different type from any of those whose habits we already knew.[1] It had a very sharp nose that



(FIG. 4.) THE SAND DARTER.

projected over its mouth; its body was exceedingly slim and round, as transparent as jelly, but firm and wiry to the touch. Its belly and much of its back, after a fashion peculiar to itself, were quite bare of scales, and those along the sides were small and inconspicuous. These peculiarities seemed the more striking as the other darters are scaly, and, along the middle line of the belly especially, they are often covered with hard plates, an arrangement obviously adapted to their "crawl-a-bottom" habits.

After much searching through the scattered and unsatisfactory descriptions which eastern naturalists have given us of the darters found in their bottles of alcohol, we decided that our little friend was the "pellucid darter," or better, the "sand darter" (*Pleurolepis pellucidus*[2] Agassiz), for reasons soon to be given.

[1] American Naturalist, June, 1876. Page 335.

[2] As this species is quite imperfectly known to naturalists, we here subjoin its synonymy and a description taken from the average of numerous specimens.

"*Etheostoma pellucidum* Baird MSS., 1853."

Pleurolepis pellucidus Agassiz in Putnam's Bulletin Mus. Comp. Zoöl., 1863, 5. Cope, Cyprinidæ of Penn., Supplement, 1866, 401. Le Vaillant, Recherches sur les Poissons, etc., 1874 Jordan, Indiana Geol. Survey, 1874, 214. Manual Vertebrates, 1876, 221. Jordan and Copeland, Check-List, Bull. Buffalo Soc. Nat. Hist., 1876, 135. Nelson, Bull. Ills. Mus. of Nat. Hist., Dec., 1876, p. 35. Jordan and Gilbert, Fishes of Indiana, Indiana Farmer for Jan. 17, 1877.

Our aquarium had been arranged for the convenience of our old etheostomoid friends, and the bottom was thickly covered with stones, among which a small fish might easily hide. Several days passed after the introduction of the first *Pleurolepis* that survived the change of water, when it was noticed that it had disappeared. Careful search among the stones and around the geode only made it the more certain that it had gone, and increased our wonder as to the way, for surely it had not been eaten, nor had it jumped out, unless like Ariel it could assume a "shape invisible." Finally, after retracing every inch of the ground, there was discovered under the nose of Boleosoma, which was standing as usual on its hands and tail, the upper edge of a caudal fin, and on each side of Boly's tail appeared a little black eye set in a yellow frame. Pleurolepis was buried! Was he dead? Slowly one eye was closed in a darter's inimitable way, for they can outwink all animals in creation except owls, and the touch of a finger on its tail showed that it had lost none of its activity. It was quite improbable that it had been accidentally buried so completely, a small spot, therefore, was cleared of stones, leaving the hard white sand exposed, and we awaited developments.

There for days we watched it closely, only to learn that it could bury itself with great celerity, for it was never caught in the act. Our patience was at last rewarded, however, for as we came out to breakfast one morning it put its nose, that we now

Generic Characters. Body nearly cylindrical, very slender, the depth being contained six to eight times in the length of the body, to base of the caudal; the breadth of the body about the same as the depth; head long, pointed, the upper jaw longest; lateral line very distinct, complete; scales thin, small, punctate, especially above, with fine black dots, far apart and deeply imbedded, obscure on the back, but generally present; wanting on the belly, readily evident only along the lateral line and on the opercles; fins rather low (as compared with other darters), the dorsal fins well separated; anal spines two; intermaxillaries projectile, the skin of the upper lip not continuous with that of the forehead; teeth minute, on jaws and vomer; mouth comparatively wide, much as in *Etheostoma*; branchiostegals six, their membrane broadly connected across isthmus.

Specific Characters. Head four to four and half in length of body, without caudal; eye large, rather high up, its diameter a trifle less than length of snout, forming about one fourth of the length of the head; iris gilt. Body pinkish-white, or faintly olivaceous, perfectly pellucid in life; a series of small squarish olive blotches, lustrous steel blue in life, along the back and another on each side, these connected by a gilt line. Fin rays: D. x. 9; A. ii. 8; first dorsal longer and lower than second, which is smaller than the anal fin. Length two to three inches.

Habitat. Ohio Valley, Youghiogheny R. (Cope), Eastern Ohio (Dr. Kirtland's Coll.), White R., Ind. (Jordan and Copeland), frequenting sandy bottoms of clear streams.

Pœcilichthys vitreus, Cope (Proc. Am. Phil. Soc., 1870, p. 263), probably belongs to this genus.

know has a tip nearly as hard as horn, against the bottom, stood nearly straight on its head, and with a swift beating of its tail to the right and left was in less than five seconds completely buried. The sand had been violently stirred, of course, and just as it had nearly settled, probably in less than half a minute, its nose was pushed quietly out and, settling back, left the twinkling eyes and narrow forehead alone visible.

Since then we have kept scores of them in an aquarium arranged especially for their convenience, and have often seen them burrow into the sand. They will remain buried as long as the water is pure and cool, and indeed we now rely nearly altogether upon them to warn us when the water needs changing. They then come out and lie on the bottom, panting violently. We have been unable to discover any immediate incentive for the act. It seems to be entirely unpremeditated. A number of them in confinement lie helplessly on the bottom, motionless and slowly breathing, when one suddenly starts and buries its head and neck in the now whirling sand by a motion as quick as thought, a headless tail beats frantically about, and when the clean sand lies smoothly on the bottom again the little eyes are looking at you like two glistening beads, as if to witness your applause at so clever a trick.[1]

We never have seen a Pleurolepis taste of food, nor do we expect to, for although its mouth bristles with teeth its small size forbids an attack on any game which we can offer. Its quiescent habits, and the character of the bottoms to which it confines itself, seem to indicate that its prey is minute if not microscopic. But speculation about what we don't know as to its food might lead us to speculation as to the mode of evolution of its characteristic features; how, for instance, the hard snout and the burrowing habits are consequent upon the loss of scales, or how the loss of unnecessary scales are consequent on its burrowing habits, matters not within the defined scope of this article.

Specimens of this species may be readily obtained in regions where it occurs. We have taken at one drawing of a fine-meshed minnow net, no less than twenty-four individuals over a sand-bar in White River, above Indianapolis, where the usual depth of the water is about two feet.

[1] Since this article was written, a small Boleosoma (*B. brevipinne* Cope), in Professor Copeland's aquarium has been noticed to bury himself in the sand as persistently as the Pleurolepis does, and in similar fashion. In no other individual of this species, and in no other species excepting the "Sand Darter," have we noticed this habit, although during the last two years we have had hundreds of individuals under examination. — D. S. J.

OBSERVATIONS UPON THE DISTRIBUTION OF PLANTS IN NEW HAMPSHIRE AND VERMONT.[1]

BY WILLIAM F. FLINT.

EVERY one who has botanized must have observed that many of the species common in one part of the country are elsewhere replaced by different ones. We are often surprised to learn that our neighboring botanists find species with which we are most familiar to be only local or altogether wanting in their vicinity.

I have been able to learn of but few attempts to find out the manner in which our New England flora is distributed, or to ascertain the causes which have placed our plants as we find them now.

I do not claim to point out many of the latter, but hope that a few facts as to the manner in which some of the plants in the Connecticut Valley, and elsewhere in New Hampshire and Vermont, are found to be distributed, may not prove wholly uninteresting. I shall not attempt to classify them in the same order as we find them arranged in the manuals, but present them, as nearly as possible, as they would be seen to occur by an observer in journeying from the sources of the rivers toward the sea.

The most important, probably, of the causes which limit the range of different genera and species of plants is that of *altitude*, or the height of the land above the sea-level, as this serves to produce the same differences in the temperature over a small extent of country, which change in latitude does over a larger one.

The flora of Northern New England presents two well-marked divisions, depending mainly upon the different temperature caused by this difference in elevation, which have been termed the Alleghanian and the Canadian. The former is represented by forests composed of chestnut, oak, pitch and red pine, and the latter where spruce, fir, arbor vitæ, and beech predominate.

It is not possible to draw a definite line for the meeting of these two floral districts, because differences of soil and the power which plants have of adapting themselves in some degree to climatic changes bring about a meeting ground of varying width between them.

Were one at the sources of the Connecticut, he could not fail to remark the very different appearance of the flora from that of

[1] A paper read before the meeting of the Connecticut Valley Botanical Society, held at Hanover, N. H., June 6, 1876.

Massachusetts. Here, black spruce (*Abies nigra*), white spruce (*A. alba*), and arbor vitæ (*Thuja occidentalis*), take the place of the oaks, hickories, and pitch pines of this river further south. These, together with the beech (*Fagus ferruginea*), sugar-maple (*Acer saccharinum*), the canoe and yellow birch (*Betula papyracea* and *B. lutea*), constitute the greater part of the forest and present a good type of the Canadian wilderness.

Here, also, Labrador tea (*Ledum latifolium*) and the Canada blue-berry are the representatives of the multitude of ericaceous shrubs found further south. The high cranberry tree (*Viburnum Opulus*) may be found throughout the valley, but in this region it finds its proper home, occurring in abundance along the streams. With it is the hoary willow (*Salix candida*), which, as it is common throughout Northern New Hampshire and Vermont, and extends into Maine, may be considered as a strictly Canadian species.

Two or three species of *Glyceria*, blue-joint grass (*Calamagrostis Canadensis*), timothy (*Phleum pratense*), and redtop (*Agrostis vulgaris*), represent the greater part of the grass family (*Gramineæ*) belonging to this region. The ponds and slow streams are more likely to contain the variety *pumilum* of the yellow water-lily (*Nuphar advena*) than the typical form.

Going southward, we find that the white spruce (*Abies alba*) disappears from the New Hampshire side of the river at North Stratford; but, singularly enough, it is still found along the Vermont side as far as to the mouth of the Passumpsic River.

At Dalton, N. H., near the head of Fifteen Miles Falls, the hoary willow (*Salix candida*) disappears. The purple meadow-rue, which seems to have a truly Canadian habitat, continues common throughout the length of this long rapid, and is last seen at the Nine Islands near the mouth of the Passumpsic.

The Canadian character of the flora predominates nearly to the foot of these falls, or to within six hundred feet of the sea-level. Here are to be found maiden-hair (*Adiantum pedatum*), *Orchis spectablis*, sweet-fern (*Comptonia asplenifolia*), frost grape (*Vitis cordifolia*), and sheep-laurel (*Kalmia angustifolia*), forming the first group of strictly Alleghanian species.

As these plants are found in other parts of New Hampshire to have this altitude above the sea at their northern limit, the contour line of six hundred feet can be taken for our purpose, as the dividing line between the two districts.

But there is no disappearance of Canadian species until we

reach the mouth of the Lower Ammonoosuc and Wells rivers. There the Labrador tea (*Ledum latifolium*) is altogether wanting, and the arbor vitæ and high cranberry tree become much less numerous.

The forests which cover the high terraces at the mouth of these rivers are composed of pitch and red pines (*Pinus rigida* and *P. resinosa*) and white oaks (*Quercus alba*).

Mountain rice grasses (*Oryzopsis Canadensis* and *O. asperifolia*) first appear in these woods, which would indicate that they as well as the trees are Alleghanian. A few miles south of this, at Haverhill, N. H., hackberry (*Celtis occidentalis*) and bitter hickory (*Carya amara*) are added, and below this point the Alleghanian type of vegetation predominates in the immediate vicinity of the river. Arbor vitæ and the mountain alder (*Alnus viridis*) are the only Canadian species present, and these find their southern limit at the White River Narrows between Hanover and White River Junction.

Azalea nudiflora is the most noticeable addition before reaching North Charlestown, where we abruptly meet with a group of trees common throughout the valley in Massachusetts. These are chestnut (*Castanea vesca*), yellow oak (*Quercus coccinea*, var. *tinctoria*), shell-bark hickory (*Carya alba*), button-wood (*Platanus occidentalis*), and, growing in their shade, the huckleberry (*Gaylussacia resinosa*) and the rattlesnake weed (*Hieracium venosum*).

Bellows Falls, Vt., seems to be the next place for the appearance of another group, apparently marking the northern limit of dwarf sumac (*Rhus copallina*), shrub oak (*Quercus ilicifolia*), summer grape (*Vitis æstivalis*), liberty tea (*Ceanothus Americanus*), cranesbill (*Geranium maculatum*), *Aster lævis*, *Solidago gigantea*, *Bidens chrysanthemoides*, *Cassia Marilandica*, butterfly weed (*Asclepias tuberosa*), spice bush (*Lindera Benzoin*), foxtail grass (*Aleopecurus pratensis* and *A. geniculatus*), *Calystegia spithamæa*, and *Vaccinium vacillans;* quite an array of species which seem to have found these falls an effectual barrier to their march northward.

Along the valley between Bellows Falls and Brattleboro are the high blue-berry (*Vaccinium corymbosum*) and *Andromeda ligustrina*, but it is not quite certain whether or not they should belong with this group.

The cotton-wood (*Populus monilifera*) first appears on an island in the river near the north line of Westmoreland, N. H.,

and is seen very commonly in the immediate vicinity of the river as far south, at least, as the Massachusetts line. Spoon-wood (*Kalmia latifolia*) and gray birch (*Betula alba*, var. *populifolia*) find their northern limit in this town at a point opposite Dummerston, Vt. South of Brattleboro, deer grass (*Rhexia Virginica*), false fox-glove (*Gerardia flava*) and at the mouth of the Ashuelot River in Hinsdale, N. H., *Cornus paniculata* and *Alnus serrulata*, are the principal additions before reaching Massachusetts.

Beside these there are others, and they would probably make up a much larger list, which are probably never found at these northern limits growing at an altitude much above that of six hundred feet above the sea, but for which I have not been able to gather sufficient data to warrant making the same approximation.

I will mention the northern limit at which I have observed a few of them: moon-seed (*Menispermum Canadense*), ground-nut (*Apios tuberosa*), near Windsor, Vt.; *Desmodium Canadense* and *Betula lenta* at South Charlestown, N. H.; *Prunus pumila*, islands of the river near Quechee Falls in Plainfield, N. H.; *Aster undulatus* and water-plantain (*Alisma Plantago*) at Hanover; *Viola sagittata* and river beech (*Carpinus Americana*) at Haverhill, N. H. *Calystegia sepium* and Virginia creeper (*Ampelopsis quinquefolia*) occur as far north as Lancaster, N. H., but are probably Alleghanian species which have been hardy enough to extend thus far northwards in spite of the increased severity of the climate.

The coltsfoot (*Tussilago Farfara*), if an introduced plant, must have entered the Connecticut Valley by the way of Canada, and seems to find the soil and climate north of Dalton best adapted for its growth, being abundant on the high clay banks of the river and along the mountain tributaries, but occurring much more rarely below the altitude of six hundred feet.

The distribution of the different species of grapes belonging to this valley is somewhat interesting. *Vitis cordifolia* is the hardiest, extending as far north as the foot of Fifteen Miles Falls. The summer grape (*Vitis æstivalis*) has not established itself north of Bellows Falls. I have been unable to find that the fox-grape (*Vitis Labrusca*) is indigenous anywhere in this valley, north of Massachusetts; but it is common along Miller's River and its tributaries in that State, which would indicate that the northern point for this species is near its mouth.

A few species seem to have found the valley of the Ashuelot River better suited to their growth than the main river valley north of its mouth. We find the flowering dogwood (*Cornus florida*) at Hinsdale; *Sagina procumbens*, *Cyperus filiculmis*, and *C. strigosus*, common along the plains of Keene and Swansey; and in the swamps, *Symplocarpus fœtidus*, which attains a greater range than the others, having established itself in the bogs around the base of Monadnock.

In the Merrimack Valley and that part of New Hampshire east of it, Canadian plants are fewer in numbers, both of species and individuals, than in the same latitude of the Connecticut Valley. Also, owing probably to the greater distance from the high lands, and to being much nearer the ocean, we find many Alleghanian species which do not extend in the Connecticut Valley farther north than Central Massachusetts.

It is somewhat surprising to any one familiar with that part of New Hampshire occupied by the Connecticut and its tributaries, to find the district belonging to the Merrimack the richest floral region in the State, and this, too, notwithstanding that the soil is not nearly so fertile. But it only proves that the warmer temperature of Eastern New Hampshire is more than enough to compensate for any decrease in the number of species that might be brought about by a less fertile soil.

We here find that the species traced throughout the former region do not seem to arrange themselves in groups with wide intervals between them, nor do their limits always appear in the same order.

In the Pemigewasset valley the frost grape first appears near the mouth of the East Branch, but nothing is seen of sheep laurel (*Kalmia angustifolia*) and sweet-fern (*Comptonia asplenifolia*) until near Plymouth, twenty miles further south. Arbor vitæ (*Thuja occidentalis*) stops near the south line of Thornton, but its companion, *Alnus viridis*, continues somewhat common to where the junction of the Pemigewasset and Winnipesaukee rivers forms the Merrimack.

A short distance south of the mouth of the East Branch, near the south line of Campton, *Pinus rigida*, *P. resinosa*, and gray birch (*Betula alba*, var. *populifolia*), make their appearance, and the white oak (*Quercus alba*) before reaching Plymouth, but the chestnut is wholly wanting north of the mouth of Smith's River, a short distance below Bristol. *Rhus copallina* is abundant at Livermore's Falls, just north of Plymouth. *Vaccinium vacillans*

and *Quercus ilicifolia* have their northern limit at Boscawen, shell-bark hickory and huckleberry at the mouth of Winnipesaukee River, while buttonwood (*Platanus occidentalis*) is found along the banks of the Pemigewasset, nearly to Plymouth. Mountain laurel (*Kalmia latifolia*) extends north to Concord, and *Asclepias tuberosa* to Thornton's Ferry.

From Concord to Nashua, we find near the river the following species, which appear to be wanting in that part of the Connecticut Valley belonging to New Hampshire. Commencing at Concord we find red ash (*Fraxinus pubescens*), *Clethra alnifolia*, *Scirpus sylvatica*, and *S. microcarpa*. The sand hills at Hooksett are sprinkled with bird's-foot violet (*Viola pedata*). The plains opposite Amoskeag Falls support a dwarf oak (*Quercus prinus*, var. *humilis*), which continues to be abundant, forming along with *Quercus ilicifolia* the shrub-oak thickets so common to these sand plains. Here, also, the bear-berry (*Arctostaphylos Uva-ursi*), generally supposed to be a highland species, occurs in greater abundance than elsewhere in the State.

Some of the swamps in this vicinity are filled with *Cupressus thyoides*, the white cedar of all the coast towns of Massachusetts. Another tree common to the borders of these cedar swamps in the same localities, the swamp white oak (*Quercus bicolor*), appears at the mouth of the Souhegan River, and *Salix tristis* is the common willow of the dry plains in this vicinity. Near Nashua we have *Aster patens*, blazing star (*Liatris scariosa*), sea sand-reed (*Calamagrostis arenaria*), prickly ash (*Zanthoxylum Americanum*), and in the adjoining town of Hudson the climbing fern (*Lygodium palmatum*). *Struthiopteris Germanica*, the ostrich fern, seems to be properly a Canadian species, not occurring south of Concord in this valley.

We find the water-shed between the Merrimack and Connecticut to have a predominant Canadian flora as far south as the latitude of Bellows Falls. Below this point the Alleghanian plants have found the temperature such as to allow them to attain to higher elevations, and to mingle with the northern types, and the strictly Canadian forest is limited to the cold swamps and summits of the highest hills.

From the data which I have been able to collect concerning Vermont, it appears that the greater portion of the State is occupied by the Canadian flora, and that the area occupied by white and black spruce and arbor vitæ is considerably greater than that occupied by the same trees in New Hampshire; the Alleghanian

area, aside from that of the Connecticut Valley, being included in a narrow belt extending the entire length of the State west of the Green Mountains. Throughout its extent white oak, bitter hickory, pitch and red pine, sweet-fern and frost grape are common, mingling at the northern end of Lake Champlain with the Canadian arbor vitæ and white spruce. The chestnut, buttonwood and mountain laurel probably do not exist much north of Burlington.

The following species which are to be met with in New York and further westward do not appear to be found east of the Connecticut Valley, and most of them are confined to the immediate vicinity of the river: *Carya amara*, *Celtis occidentalis*, *Populus monilifera*, *Salix longifolia*, and *Salix livida*, var. *occidentalis;* the last one of these having the widest distribution being found throughout the entire valley, but apparently not passing over the water-shed into the Merrimack district. The hairy-leaved white violet (*Viola renifolia*, Gray; n. sp.) is to be met with between the mouth of the Passumpsic and Plainfield, N. H.

The following may be called rare, having but a single locality for each: *Lobelia Kalmii*, ledges at the foot of Fifteen Miles Falls; *Cypripedium pubescens*, at Hanover; *Arabis Drummondii*, on an island in the river just south of White River Junction; and *Astragalus Robbinsii*, rocks at Quechee Falls, Plainfield, N. H.

THE SUESSONIAN FAUNA IN NORTH AMERICA.

BY PROF. E. D. COPE.

IN a paper read before the National Academy of Sciences at the spring session of 1876 in Washington, the writer announced the identification of the Wahsatch Eocene formation of New Mexico with the Suessonian or Lower Eocene of France and England. The beds, which were explored while connected with the United States Geographical and Geological Survey, west of the one hundredth meridian, in charge of Lieut. G. M. Wheeler, in 1874, were found to contain the remains of a fauna, almost identical with that of the European beds in question. This was thought to be an important accession to American geology, as furnishing a basis for an estimation of the relative ages of the ormations immediately above and below the Wahsatch horizon. The parallelism of the fauna includes the genera of reptiles, birds,

and mammals, and among the latter, of the types both of carnivorous and of hoofed quadrupeds. Gar-fishes (*Lepidosteus*) appear in both countries, and the predominant mammalian genera of both are *Coryphodon* and *Hyracotherium*. Gigantic birds inhabited the land; in New Mexico they belonged to the genus *Diatryma*, and in France to *Gastornis*. The New Mexican genus *Ambloctonus* represents the carnivorous *Palæonyctis gigantea* of the lignites of Soissons. The only marked difference between the faunas which the then state of discovery disclosed is the existence of the order *Tæniodonta* in New Mexico, a type presenting characters of the *Edentata*, *Rodentia*, and *Creodonta*, which had not yet been found elsewhere.[1]

The characters of the mammalian fauna are very peculiar, displaying inferiority in many respects. Thus, among the flesh-eaters the brain of the *Oxyæna* is of reduced size, the hemispheres being especially small, while the olfactory lobes are very large and uncovered; and other Creodont genera present the same character. According to Gervais the genus *Arctocyon*, from the Suessonian, presents the same type of brain. The hoofed type, *Coryphodon*, shows a similar inferiority in the constitution of the brain.

So far as these observations have gone, they coincide with those made eight years ago by Professor Edouard Lartet of Paris. He states[2] that it is the result of a number of investigations undertaken in different horizons of the Tertiary strata, that the more we follow *Mammalia* into the antiquity of geological time, the greater is the reduction of the volume of the brain in comparison with the size of the head and the total dimensions of the body. Cuvier observed the form of the brain of the *Anoplotherium* in a cast of marl which was consolidated within the cavity of a skull of this animal, found in the gypsum of Montmartre. He says[3] "it has little volume, and is flattened horizontally; the hemispheres do not present convolutions, but we find only a shallow longitudinal impression on each. All the laws of analogy authorize us to conclude that our animal was greatly deficient in intelligence." In fact the skull of the *Anoplotherium* is six times as long as the cast of its cerebral hemispheres, and this animal, which in dimensions Cuvier compared to a medium-sized ass, had a brain smaller than that of the existing roebuck.

[1] See American Naturalist, 1876, p. 379.

[2] Comptes rendus, June, 1868.

[3] Ossements fossiles, iii., p. 44.

"I owe to the kindness of Professor Noulet, of Toulouse, the possession of a fossil cranium in which I have found the cast of a brain still more ancient than that of the *Anoplotherium* of Montmartre, since the fragment comes from the Eocene of the *Lophiodon* of Issel. In the brain of this animal (which I call provisionally *Brachyodon eocænus*, on account of the slight elevation of the crowns of the molar teeth), there are no longer any convolutions, but only certain folds irregularly graduated; the olfactory lobes are much prolonged in front, and the cerebellum is entirely separated from the hemispheres. This brain is smaller in all respects, and less complicated in its structure than that of the *Cœnotherium* described by Gratiolet; but it must not be forgotten that the latter animal is from a formation much more recent, that is, the inferior Miocene of Allier.

"In proportion as we approach the present period, the differences between the fossil brains and those of living species become less marked, as has also been observed with reference to the elevation of the crowns of the molars. Thus the deer and the antelopes of the Middle Miocene of Sansan present many convolutions, while the cerebellum remains moderately uncovered, and the olfactory lobes are very prominent. In the superior Miocene of Pikermi the brain of the *Hippotherium* (*Hipparion*) shows itself a little less rich in convolutions than that of the existing horse; and in a fragment of a skull of a monkey from the same locality, which I have been permitted to examine in the museum, the cerebellum is less completely covered by the hemispheres, and the median vermis is more prominent than in the living *Semnopitheci* of the types most nearly related to those of Pikermi. But in order to show more clearly this disproportion of the fossil brains in relation to those of living *Mammalia*, it is necessary that comparison should be made between species of the same family, or, better still, of the same genus. It has been possible for me to verify this point by the comparison of two carnivorous animals, the living *Viverra genetta*, and the extinct *V. antiqua* of De Blainville, from the inferior Miocene of Allier. From this it appears, that with a cranium one third longer and one fourth wider than the living *V. genetta*, the fossil *V. antiqua* has not a larger brain, and that this brain, more attenuated in its frontal convolutions, does not extend so far forwards. According to Gratiolet a great development of the olfactory lobes is a character of an inferior type. In fact the more we ascend into palæontological antiquity the more we find that the olfactory

lobes display a great development in comparison with the cerebral hemispheres."

The Wahsatch horizon is lower than the oldest above referred to by Professor Lartet, and it is interesting to observe how his generalization with reference to the characters of the mammalian brain is confirmed. The *Oxyæna forcipata* approaches more nearly to the viverrine type than to any other form of the *Carnivora*, although separated by a wide interval. I have been able to obtain a cast of the superior and anterior portions of its cranial chamber, from which it appears that the brain possessed characters of a much lower type than that observed in the *V. antiqua*. The olfactory lobes are enormously developed, rising higher than the hemispheres, from which they are not only entirely free, but are separated by a constriction of their basal portions. The hemispheres are not wider at the middle than the olfactory lobes, and have therefore elongated proportions. Their superior portion is without convolutions. Although not a marsupial, the general form in *Oxyæna* is more like that of the opossum than that of any other living animal, but is still lower in character. Its inferiority is especially seen in its small size. The mandibular ramus of the *O. forcipata* is about the size of that of the jaguar, but the brain, even with its large olfactory lobes, is only about two thirds as long, and one third as wide.

The ankle-joint presents a great simplicity of structure in most of the Wahsatch mammals, both flesh-eaters and hoofed types. The astragalus is nearly flat, and not like a segment of a pulley as in most existing *Mammalia*, and it therefore permitted but little flexure of the foot on the leg. The only exception to this rule is found in the species of *Hyracotherium* and allies of the order *Perissodactyla*, which number ten species out of a total of fifty-four.

As regards the elbow-joint a similar peculiarity was discovered to exist. In the majority of existing mammals, a ridge or bead divides the two facets of the humerus, which receive the ulna and radius respectively; it is called the intertrochlear ridge. In the ox and horse this ridge is very near the external border of the humerus. In the mammals of the Wahsatch beds this ridge was found to be wanting, excepting in the ten species of *Perissodactyla* above mentioned.

In respect to the teeth, no species presenting the selenodont or double-crescent bearing type had been found. Of the simpler types, where tubercles are united into crests, twelve species out

of fifty-four had been discovered. The teeth of the remaining forty-two species are bunodont or tubercular only, and in most cases simple forms of that type.

Another marked feature of the Suessonian or Wahsatch *Mammalia* is the possession by the greater number of them of five toes on both of the feet. The only probable exceptions to this rule are the ten species of *Perissodactyla* already mentioned, and perhaps a very few others. The genera of later and the present periods with three toes on all the feet, with two functional toes, and one toe, are wanting in this fauna.

It was also asserted that nearly all of the species were plantigrade in their mode of progression, that is, that the soles of the fore and hinder feet were applied to the ground, instead of being obliquely elevated behind, the heel thus appearing to form an angle of the leg, as in most living mammals. It is well known that among recent quadrupeds the *Quadrumana*, Plantigrade *Carnivora*, *Proboscidia*, and some *Rodentia* and *Edentata*, are plantigrade, while the others are digitigrade. The only species of the Wahsatch fauna possibly digitigrade are the species of *Perissodactyla*, already mentioned, although it was stated that the structure in a few of the other genera is yet unknown.

The agreement of clawed and hoofed (unguiculate and ungulate) mammals of this period in the general imperfection of the structure of the brain, of the ankle and elbow-joints, and in the position and number of the toes, was dwelt on as an important fact. It did not however warrant the separation of all the *Mammalia* of the Suessonian as a distinct order, on account of the exceptions pointed out. The clawed types presenting these characters have been since [1] defined as an order, under the name of *Bunotheria*, which it was believed might embrace also the existing *Insectivora* as a suborder. The ungulates of like character have already been erected into a distinct order, the *Amblypoda*, which includes two suborders, the *Pantodonta* and *Dinocerata*. The only mammalian orders of that period still existing are then the *Perissodactyla* and *Rodentia*.

[1] Proceedings Academy, Philadelphia, 1876, page 88

ON THE VITALITY OF CERTAIN LAND MOLLUSKS.

BY ROBERT E. C. STEARNS.

AT a meeting of the California Academy of Sciences I submitted for the inspection of the members a living specimen of *Bulimus pallidior* Sby., one of nine given to me by Professor George Davidson, who collected them at San José del Cabo, Lower California, in March, 1873.

These snails were kept in a box undisturbed until June 23, 1875, when I took them out and, after examination, placed them in a glass jar with some chick-weed and other tender vegetable food and a small quantity of tepid water, so as to make a warm humid atmosphere. This hospitable treatment induced them to "wake up" and move about after their long fast and sleep of two years, two months, and sixteen days. Subsequently all died but the one exhibited, which seems to be in pretty good health, though not very active.

It may be remembered that I gave at a meeting of the Academy in March, 1867, an instance, even more remarkable, of vitality in a snail (*Helix Veatchii*) from Cerros Island, the latter having lived without food from 1859, the year when it was collected, to March, 1865, a period of six years.

The famous specimen in the British Museum, which is cited in the books, *Helix desertorum*, had lived within a few days of four years, fastened to a tablet in one of the cases, when discovered to be alive. *Helix desertorum*, as the specific name implies, is found in arid and sterile areas in the continents of Africa and Asia, and has, as will be perceived, a wide distribution. From the former continent, I have specimens from Egypt, and it also ranges through Arabia in the latter. The *Bulimus* from the mainland of the peninsula of Lower California, and *Helix Veatchii* from Cerros or Cedros Island, off the coast on the ocean side of the same, come from within the same physical environment, being only a comparatively limited distance apart. The *Helix* belongs to an interesting and peculiar group, probably varieties of one species, which includes, at present, the following names: (1) *Helix areolata* Sby., (2) *H. Veatchii* Newc., (3) *H. pandoræ* Fbs., and (4) *H. levis* Pfr. Other forms geographically approximate may hereafter on further investigation be referred to the same lineage. Of the above (1) *H. areolata* was the first described, or I should say that this appears by the date to be the first name bestowed upon any member of the group. This

species has been quoted from Oregon, and (4) *H. levis* from the Columbia River, in both cases erroneously. The figures in Land and Fresh Water Shells of North America,[1] page 177, are too elevated and globose for the typical *areolata*, but the larger figures faithfully represent *H. Veatchii*. Elevation and rotundity are insular characteristics in this group, and *areolata* is somewhat depressed. It is found in comparative abundance on the uplands around Magdalena Bay, which is on the outer or ocean shore of the peninsula, in latitude about 24° 40′ N.

Bulimus pallidior, which is pretty generally distributed through Lower California, from Cape St. Lucas northerly, has also erroneously been credited to San Diego in California proper.

It is arboreal in its habits, at least during the winter season, being found on copaiva trees. It has been said to inhabit South America, which is probably incorrect, and the locality "San Juan" mentioned in Land and Fresh Water Shells, on page 195, where a good figure of this species may be seen, should be *San Juanico*, which is on the east or gulf side of the peninsula, in latitude about 27° N.

The great importance of accuracy in habitat will be at once perceived when I state that there are no less than *three* other localities on the west coast of America, *north* of the place cited, all of which are referred to in various scientific works, which have come under my observation as San Juan, and there are perhaps as many more San Juans, *south* of that especially quoted herein, on the westerly coast of America, in the Central and South American States. Attention is directed to the fact that the three species here mentioned as exhibiting extraordinary vitality belong to geographical areas which receive only a minimum rainfall, or which are, in simple language, nearly rainless regions.

Within such areas vegetation is exceedingly limited even in favorable seasons, and the presence and growth of the annual plants is of course dependent upon the rainfall; this last occurring infrequently makes the food supply of land mollusks and other phytophagous or vegetable-eating animals exceedingly precarious.

It is highly probable that a careful investigation in this direction will lead us to the conclusion that the land mollusks which inhabit these arid areas have, through selection, adaptation, and evolution, become especially fitted for the contingencies of their

[1] Smithsonian Misc. Coll., No. 194.

habitat, and possess a greater degree of vitality or ability to live without food than related forms in what may be considered more favorable regions, and through and by reason of their long sleep or hibernation (more properly æstivation), with its inactivity and consequent immunity from any waste or exhaustion of vital strength, are enabled to maintain their hold upon life when animals more highly organized would inevitably perish; and we are furnished with an illustration in the instances cited, how nature works compensatively, when we institute a comparison with the opposite condition of activity, and the food required to sustain it.

BARNACLES.

BY J. S. KINGSLEY.

QUAINT old Gerarde in his Herball, or Generall Historie of Plantes, says, on page 1391, "We are arrived to the end of our historie, thinking it not impertinent to the conclusion of the same, to end with one of the marvels of this land (we may say of the world). . . . . There are founde in the north parts of Scotland, and the islands adjacent, called Orchades, certaine trees whereon doe growe certaine shell fishes, of a white colour, tending to russet, wherein are contained little living creatures; which shels, in time of maturitie, doe open, and out of them growe those little living things which falling into the water doe become fowles, whom we call Barnakles, in the North of England Brant Geese, and in Lancashire Tree Geese: but the other that doe fall upon the land perish and come to nothing." He then goes on to describe in detail the various transformations by which the barnacle is changed into a goose, saying, "But what our eies have seene and hands have touched, we shall declare." He tells us that when the bird is formed in the shell, the latter gapes, the legs hang out, the bird grows larger, until at length it hangs only by the bill and soon after drops into the water, "where it gathereth feathers and groweth to a fowle bigger than a mallard and lesser than a goose."

A quotation in Walton's Complete Angler repeats the same curious notion: —

> "So slow Boötes underneath him sees
> In th' icy islands goslings hatched of trees,
> Whose fruitful leaves falling into water
> Are turned tis known to living fowls soon after.

So rotten planks of broken ships do change
To Barnacles. O transformation strange!
'T was first a green tree, then a broken hull
Lately a mushroom, now a flying gull."

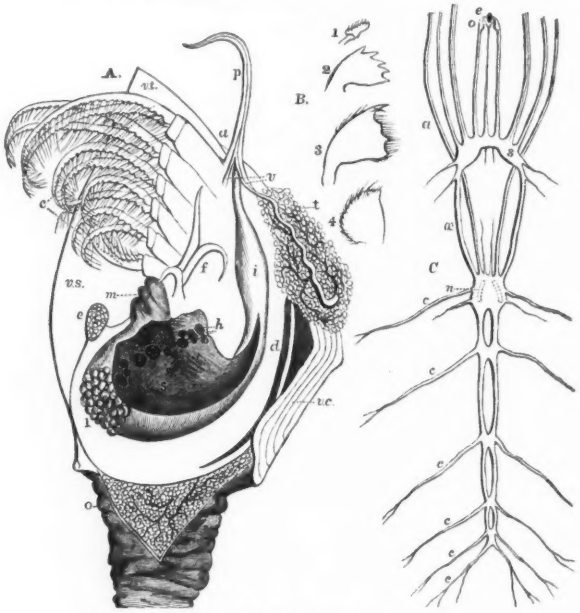
The transformations described by the above authors are, it is needless to say, founded wholly upon fancy, but the metamorphoses observed in a study of the life-history of a barnacle are scarcely less wonderful than those so minutely related by the old botanist. The old idea is still perpetuated in the names of two animals: that of the "Barnacle Goose" (Bernicla), and in the specific name of one species of barnacle, the *Lepas anserifera* of Linnæus.

Barnacles were at first classed among the Mollusca, on account of their calcareous valves, as were at a later date the Brachiopoda; but in 1828–29 John Thompson proved, by studies of their embryology, that they had absolutely no molluscan affinities, but that they were Crustacea. Later investigations of their anatomy have confirmed this and they are now accorded a place among the lowest Crustacea, the Rhizocephala only being below them.

They form the sub-class Cirripedia, and are divided into two orders: the first is the pedunculated Cirripedia, in which there is a *capitulum*, generally formed of calcareous valves, varying in number, and united by membranes, and a tough leathery stalk, the *peduncle*, by which they are attached; in the other order, the sessile Cirripedia, the capitulum has four or more of its valves immovably united, and is directly attached without the intervention of a peduncle.

In Figure 5 we give the anatomy of one of the pedunculated forms, *Lepas fascicularis* of Ellis and Solander. In this species the capitulum is composed of five valves, two on each side, and one on the dorsal edge. The ventral margin is open and the two basal valves are connected by an adductor muscle (*A*, *e*), by which this opening can be closed. To dissect a specimen, it should be placed under water in a wax-bottomed pan and pinned down. In this manner the parts float out and the various organs are easily seen. The valves of one side are removed by cutting the *adductor scutorum* muscle and the membranes uniting them. This discloses a body with six pairs of long ciliated arms, the *cirri* (*A*, *c*), which represent the thoracic feet. Each cirrus consists of a basal portion and two long jointed branches. They decrease in length as we go forward (that is, toward the peduncle). In front of these cirri we find a protruding organ formed by the

mouth parts (*A*, *m*). These consist of an upper lip to which is attached a so-called *palpus* (*B*, 1). Next follow the mandibles (*B*, 2). Then the two pairs of maxillæ (*B*, 3 and 4). The maxillipeds, which are found in the higher Crustacea, are wanting. At the base of the first cirrus arise processes, varying in number in different species, which are termed filamentary appendages (*A*, *f*). These have been supposed to be part of the respiratory apparatus, but that such is their sole function is at least doubtful.



(Fig. 5.) ANATOMY OF LEPAS FASCICULARIS.

Between the sixth pair of cirri are found two small processes consisting of one or more joints, called the *caudal appendages*, and representing the abdomen of the higher Crustacea. Beneath these arises a long slender organ, the male intromittent organ (*A*, *p*).

On opening the body, starting from the mouth, we see first a slender tube, the *œsophagus*, then comes the stomach (*A*, *s*), which connects without any defined constriction with the intestine (*A*, *i*), and terminates at the vent (*A*, *a*), between the caudal appendages. At the anterior part of the stomach are seen the hepatic openings (*A*, *h*) which connect with the liver

(*A*, *l*). The circulatory system is very imperfect. There is a dorsal vessel (*A*, *d*) which I have succeeded in injecting; the blood flows between the muscles in broad currents and is not confined in closed vessels. Respiration is probably performed by the whole surface of the body. The barnacles are generally hermaphroditic. The testes (*A*, *t*) are found surrounding the alimentary canal and extending into the filiamentary appendages and the bases of the cirri; they consist of branching tubes connecting with lobular cæca. The *Vasa deferentia* (*A*, *v*) are disposed one upon each side. They follow an undulating course and unite at the base of the penis (*p*) and proceed as a single tube to the end. The ovaries are found in the peduncle (*A*, *o*) and present the same general appearance as do the testes.

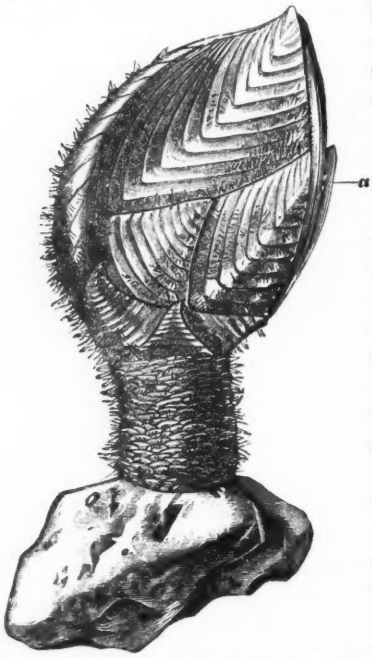
The nervous system is easily dissected by laying the specimen upon the dorsal surface (after removing all the valves) and cutting away in front of the œsophagus. This will expose the *supra-œsophageal* ganglia (*C*, *s*), which will be readily recognized, as they present the same shiny white appearance that always characterizes nerves. From the commissure connecting these ganglia a single nerve arises and proceeds forward in the median line. The optic nerves originate on each side, have each an enlargement, the ophthalmic ganglion (*C*, *o*) and unite in the rudimentary eye (*C*, *e*), which is imbedded in the membranes of the body. Exterior to these arise the nerves which supply the peduncle. From the posterior angles of the supra-œsophageal ganglia a nerve on each side (*C*, *æ*) passes backward around the œsophagus and unite in the *infra-œsophageal* ganglion (*C*, *n*). From the anterior portion of this arise the nerves which go to the adductor-scutorum (*C*, *a*) muscle; on the sides the nerves which go to the first pair of cirri have their origin; from the dorsal surface (the under surface as the specimen lies) are given off two nerves which are distributed among the viscera. The second, third, fourth, and fifth thoracic ganglia follow each other, are connected by commissures, and give rise to nerves supplying their respective cirri. The sixth ganglion is almost invariably united to the fifth, and from it arise the nerves going to the sixth pair of cirri and the penis. In one specimen, however, I have found the fifth and sixth ganglia connected by distinct commissures.

In the sessile Cirripedes the internal anatomy does not differ greatly from the form above described. They are best dissected by removing the animal through the base (the portion by which

they are attached), breaking it down if it be calcareous. One curious feature of both orders remains to be noticed, namely, two glands in the peduncle which secrete a cement by which the animals attach themselves.

We have said above that the barnacles are generally hermaphrodites. In the case, however, of the genera *Ibla* and *Scalpellum*, this is not strictly the case. In the species of these genera occur specimens of the normal hermaphroditic form, and also females in which the penis and testes are wanting; next we have curious male forms. Certain of these (complemental males they are called) are parasitic upon the hermaphrodites while others are attached to the female individuals. In both cases they live just within the valves and are attached either to the valves or the membranes of the body. These males are imperfectly developed, in some cases without mouth or alimentary canal, in others there is a long and flexible peduncle, and in still others it is not differentiated; the male genital organs are developed, but with the penis short or wanting. (Figure 6, male of *Ibla Cumingii*, from Darwin). This great difference between the sexes has its analogues in the Cephalopoda, where the males of certain species were first described as parasitic worms, and in the Lernean Copepoda, which are closely allied to the Cirripedia.

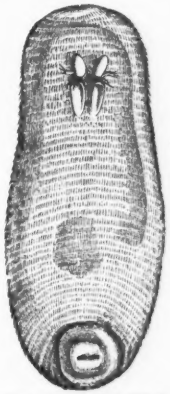
(Fig. 6.) IBLA, MALE ENLARGED.



(Fig. 7.) SCALPELLUM REGIUM. (From W. Thompson.)
a, Males lodged within the valves.

Recent investigators have shown that close fertilization is the exception, not the rule, among plants, and here seems to be a case in the animal kingdom, where nature plainly shows her preference for cross-fertilization. In those genera which are strictly hermaphroditic,

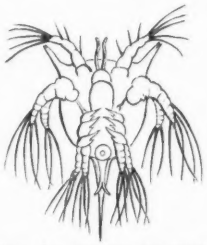
the animals either occur in groups, as in the genus *Balanus*, or the intromittent organ is extremely long, as in *Acasta*, thus enabling one individual to fertilize another. *Anelasma squalicola* always occurs in pairs in the skin of sharks. But in the two genera, *Ibla* and *Scalpellum*, the individuals are either solitary or, if in clusters, are so crowded and twisted that the apertures of the capitulum are distant from each other.



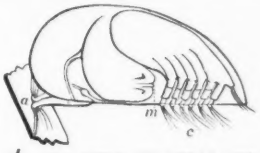
(Fig. 8.) MALE OF S. REGIUM ENLARGED. (From W. Thompson.)

The case of a simple separation of the sexes would not strike us as being peculiar; but an instance where a hermaphrodite, with fully developed testes, *vasa deferentia*, and intromittent organ, besides female organs, has within its shell from one to ten complemental males can, I think, be explained only on the ground of adaptation for cross-fertilization.

The eggs pass from the ovaries and are borne for some time inside the capitulum. They undergo a total segmentation of the yolk and hatch a Nauplius, a free swimming form with mouth, stomach, and intestine, a triangular carapace with two prominent frontal horns and a posterior spine, beneath which is seen the forked abdomen. (Figure 9, Nauplius of *Balanus balanoides?* from a MS. drawing by Dr. Packard.) They have three pairs of swimming feet, the first simple, the posterior two biramose, and all three terminating in long bristles. They soon change to a pupa form (Figure 10, pupa of *Lepas australis; a*, antennæ; *c*, cirri; *m*, mouth; from Darwin), which has the triangular shield of the Nauplius folded together in a bivalve form; the six pairs of thoracic limbs are present, and also the antennæ. After swimming about for a while the animal attaches itself by its antennæ, as shown in the figure, and undergoes a metamorphosis by which the eye becomes internal, the antennæ are concealed by the growth of the peduncle, the valves of the capitulum are formed, and, in a word, the animal attains its adult retrograde condition.



(Fig. 9.) YOUNG OF THE BALANUS, ENLARGED.



(Fig. 10.) PUPA OF LEPAS, ENLARGED.

Barnacles first appeared in the upper Silurian age. At the present day they are found in every sea, and the various species are widely distributed. Some are attached to piles and rocks; *Acasta* is found in sponges, *Lepas fascicularis* forms of its cement a float by which it is supported, *Coronula* is found in the skin of whales; *Anelasma squalicola*, as its name indicates, inhabits the skin of sharks; *Chelonobia* is found on the backs of turtles in the tropical seas. There is an interesting specimen in the Museum of the Peabody Academy of Science at Salem, Mass., of *Conchoderma aurita* which had attached itself to a Lernean Crustacean (*Penella*), which in turn was parasitic upon the large sunfish (*Orthagoriscus mola*).

The anatomy of the Cirripeds has been worked out by Burmeister, St. Ange, and Darwin. The figure of the nervous system given by St. Ange is wonderfully imperfect. It has, however, been copied by Coldstream in Todd's Cyclopædia of Anatomy, in Owen's Lectures on Invertebrate Anatomy, and Carus Icones Zoötomie. Their embryology has been studied by Thompson, Burmeister, Darwin, and Fritz Müller, while a systematic account of the subclass is given by Darwin in two volumes published by the Ray Society, to which the reader is referred for further particulars concerning this interesting group.

RECENT LITERATURE.

The Zoölogy of Wheeler's Survey.[1] — Since the spring of 1871, Lieutenant Wheeler has been conducting an examination of the biology of the Western Territories, which his parties have traversed, in connection with his geographical and geological explorations. No connected reports upon the facts and material obtained by the survey have ever been published, however, and our knowledge of them has been limited, with one or two exceptions, to brief accounts of discoveries read to scientific societies. The publication of this splendid volume of zoölogical results is therefore an event in the history of this survey, — one which is calculated to increase its friends, — and a monument to the perseverance and skillful zeal of the field naturalists.

The report contains over one thousand quarto pages, and is made in the name of Dr. H. C. Yarrow, who, until recently, was naturalist-in-charge of the survey; but he acknowledges assistance in the prepara-

[1] *Reports upon the Zoölogical Collections obtained from Portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the Years* 1871–74. Explorations and Surveys west of the One Hundredth Meridian. Lieut. Geo. M. Wheeler in charge. Volume V. Washington. 1875. 4to, pp. 1020.

tion of special features from a large corps of well-known scientific men. The opening paper treats of the geographical distribution of the animal life of the West, as shown by Lieutenant Wheeler's explorations. This is followed by the account of the mammals observed, written by Dr. Elliott Coues and Dr. Yarrow, which goes extensively into the synonomy of the species mentioned, and gives copious notes upon habits, etc. Although the collections were large there were no novelties, and hence no plates accompany this paper. Chapter III., Ornithology, is by Mr. H. W. Henshaw, and is illustrated by fifteen plates of new species or varieties of birds. They are drawn by Robert Ridgway, and well drawn, but the chromo-lithographic process of coloring has failed to give a worthy effect in several cases, and some of the plates look cheap. The text of the Ornithology is full of news, and great praise belongs to Mr. Henshaw for his active and careful observance of the manners and songs of the little-known birds of the Southwest. This is the most entertaining and the longest chapter in the volume. Dr. Yarrow himself writes the report upon the Batrachians and Reptiles, of which a large series of great value was secured, and unites with Prof. E. D. Cope in describing the fishes, which have been somewhat neglected by Western expeditions heretofore. Both of these papers are accompanied by many finely engraved plates, partially colored; and both are preceded by a discussion of general characteristics. The collections of Hymenoptera are reported upon by E. T. Cresson and Edward Norton; the Diurnal Lepidoptera, by Theodore L. Mead and W. H. Edwards; new species of *Zygænidæ* and *Bombycidæ*, by Richard H. Stretch; the Diptera, by Baron Osten-Sacken; the Coleoptera, by Henry Ulke; the Hemiptera, by Professor Uhler; the Orthoptera, by Professor Thomas; and the Neuroptera, by Dr. Hagen. Dr. Yarrow, with quite unnecessary apologies as to unfitness, presents the report upon the Mollusks, showing that even the more barren plains of New Mexico and Utah support many species of terrestrial and fluviatile mollusks, as well as the mountain meadows of the more Northern Territories; and extending almost or quite across the continent, the range of some of our common Eastern species. The final chapter is by Professor Verrill upon fresh-water leeches. This last half of the book, also, is adorned with a large number of plates finely drawn and exquisitely colored.

Weismann's Final Causes of Transmutation.[1] — Perhaps the most remarkable biological work of the year is Prof. August Weismann's treatise on the Final Causes of Transmutation, forming the second part of his Studies on the Theory of Descent. The first part of the work, entitled Seasonal Dimorphism, appeared in 1875. The present work is divided into four divisions, of which the first presents a striking array of

[1] *Studien zur Descendenz-Theorie. II. Ueber die letzten Ursachen der Transmutationen.* Von Prof. August Weismann. Mit fünf Farbendrucktafeln. Leipzig. 1876. 8vo, pp. 336.

facts on the origin of the markings of caterpillars. The author describes the nature and morphology of the markings of larvæ of the family Sphingidæ, their biological value and tribal development, concluding that the oldest Sphingid caterpillars were without markings; that the oldest style of markings were longitudinal lines, the later ones oblique streaks, and the last to be developed, the spots. This part of the subject is illustrated by five colored plates. In the third section the transformation of the Mexican axolotl into an Amblystoma is discussed at considerable length, and with characteristic thoroughness. Professor Weismann believes that the Siredon or axolotl was originally derived from a land salamander (Amblystoma), but has reverted to an axolotl, or larval form, through the change of the climate of Mexico from a damp to an exceedingly dry one, obliging these animals, which as larvæ, lived in ponds, and as adults lived under fallen trees and stones or in damp places, to revert to the original larval Siredon form and remain permanently amphibious. In the fourth division, on the mechanical conception of nature, the author maintains that development is mechanical, and that we must reject the idea of a special life-force. Still he as strongly believes in teleology, and maintains the thesis that evolutional views do not tend to materialism.

Glover's Illustrations of Insects.[1] — This is a large quarto volume, containing ten excellent copper-plates illustrating the leading types of plant-bugs (Hemiptera not including the Homoptera), with 132 pages of text, a fac-simile of the author's own handwriting, printed on prepared lithographic paper. The letterpress contains useful lists of predaceous or parasitic bugs (Heteroptera), of the vegetable or animal substances destroyed by them, and of remedies against their attacks used or suggested by various writers. The value of the work is greatly increased by the aid of Mr. P. R. Uhler, "who has materially assisted in preparing the work by furnishing the specimens from which to figure, for advice and correcting the text, for the classification and valuable notes." The edition consists of but fifty or sixty copies for private distribution, and is a storehouse of useful information for agriculturists, which we wish could be more widely published.

Lovén's Studies on the Echinoids.[2] — This elaborate memoir presents matter of special interest to the palæontologist as well as to the zoölogist and anatomist. Chiefly zoölogical in its character, the text and plates are mostly devoted to a discussion of the homologies of the shell of the sea-urchins, particularly those forms related to extinct genera of echinoids. Comparisons are also instituted with the classes of

[1] *Manuscript Notes from my Journal, or Illustrations of Insects, Native and Foreign. Order Hemiptera, Suborder Heteroptera, or Plant-Bugs.* By Townsend Glover. Washington, D. C. 1876. 4to, pp. 132.

[2] *Études sur les Échinoïdés.* Par S. Loven. (Kongl Svenska Vetenskaps-Academiens Handlingar. Bandet II., No. 7.) Text and Atlas of 53 Plates. Stockholm. 1875. 4to, pp. 91.

Asteroids (star-fish) and Crinoids, which will, if we mistake not, be found of much use to palæontologists. Especial attention is devoted to certain organs called *Spherides*, grouped around the mouth of sea-urchins, for the discovery of which naturalists are indebted to Professor Lovén.

But to our mind the most interesting portion of the work is the exquisite drawings illustrating the anatomy and distribution of the nervous system and the water system of vessels. We have here for the first time, clearly shown, the more intimate relations of these organs.

The plates are abundant and beautifully executed, the lithographs rivaling in clearness and delicacy the best steel engravings.

Macalister's Animal Morphology.[1] — Though this book was written in 1873, it is still the most recent manual of animal morphology in the English language, and will be found by advanced teachers to be very useful. The system of classification is that of Haeckel as modified by Huxley, and is based on recent embryological studies. The sponges are regarded as belonging to a distinct subkingdom, *Polystomata* of Huxley. The *Labyrinthuleæ* of Cienkowsky are admitted as a class of Protozoa. The Mollusca are regarded by the author, and we think correctly, as "only an extreme of specialization" of Vermes; in another place (page 241), "Their structure can be easily understood by regarding them as Vermes with no articulated appendages, modified by unequal lateral development, and by a fusion of metameres." For convenience they are regarded as a subkingdom. The Tunicates are placed among the Vermes in accordance with Gegenbaur's classification. The Polyzoa are placed among the Vermes, while rather inconsistently (probably because Gegenbaur first did so) the Brachiopoda are retained among the Mollusca. The volume ends with the Insects; a second volume, containing the Vertebrates, has just been issued from the press. Had we space to be critical we should feel inclined to find some fault with the author's classification of the Arthropoda, which he does not, however, claim to be original.

Recent Books and Pamphlets. — Report on the Transportation Route along the Wisconsin and Fox Rivers, in the State of Wisconsin, between the Mississippi River and Lake Michigan. By Gen. G. K. Warren. Washington. 1876. 8vo, pp. 114. With Ten Maps.

The Grotto Geyser of the Yellowstone National Park. With a Descriptive Note and Map, and an Illustration by the Albert-type Process. (U. S. Geological and Geographical Survey of the Territories, F. V. Hayden, U. S. Geologist-in-Charge.) Washington, D. C. Folio.

The History of Spontaneous Generation. By Edward S. Dunster, M. D. (From Transactions of the Ann Arbor Scientific Association. Vol. i. 1871.) Ann Arbor. 8vo, pp. 30.

Über Dimorphismus und Variation einiger Schmetterlinge Nord Amerikas. Briefliche Mittheilung von J. Boll in Texas. 1876. 4to, pp. 3.

[1] *An Introduction to Animal Morphology and Systematic Zoölogy.* By Alexander Macalister, Professor of Comparative Anatomy and Zoölogy, University of Dublin. Part I. Invertebrata. London: Longmans, Green, & Co. 1876. 12mo, pp. 461. With a few Cuts.

New England Society of Orange, N. J. Scenery. I. October, 1876. 4to.

Mesozoic Fossils. Vol i. Part I. On some Invertebrates from the Coal-Bearing Rocks of the Queen Charlotte Islands, collected by Mr. James Richardson in 1872. By J. F. Whiteaves. Geological Survey of Canada. Montreal, 1876. 8vo, pp. 92. Ten Plates and Map.

The Origin of Californian Land Shells. By J. G. Cooper, M. D. (From the Proceedings of the California Academy of Sciences, February 1, 1875.) 8vo, pp. 3.

On Shells of the West Slope of North America. By J. G. Cooper, M. D. (From the Proceedings of the California Academy of Sciences, February 1, 1875.) 8vo, pp. 17.

New Facts relating to Californian Ornithology. No. 1. By J. G. Cooper, M. D. (From the Proceedings of the California Academy of Sciences, December 6, 1875.) 8vo, pp. 14.

On the Coal and Tertiary Strata of California. By J. G. Cooper, M. D. (From the Proceedings of the California Academy of Sciences, September 21, 1874.) 8vo, pp. 15.

Pacific Coast Lepidoptera. No. 15. Description of a new Species of Catocala, from San Diego. By Henry Edwards. (From the Proceedings of the California Academy of Sciences, October 18, 1875.) 8vo, pp. 1.

Pacific Coast Lepidoptera. No. 16. Notes on the Transformations of some Species of Lepidoptera, not hitherto recorded. By Henry Edwards. (From the Proceedings of the California Academy of Sciences, April 19, 1875.) 8vo, pp. 6.

Pacific Coast Lepidoptera. No. 17. On the Transformations of Colias (Meganostoma Reak) Eurydice Bdv. By Henry Edwards. (From the Proceedings of the California Academy of Sciences, June 5, 1876.) 8vo, pp. 2.

Darlingtonia Californica Torrey. By Henry Edwards. (From the Proceedings of the California Academy of Sciences, September 6, 1875.) 8vo, pp. 6.

Notice of Sir William Edmond Logan. By T. Sterry Hunt, LL. D. (From the Report of the American Academy of Arts and Sciences, May, 1876.) 8vo, pp. 6.

On the Affinities of Hypocephalus. By John L. Leconte, M. D. (Read before the National Academy of Sciences, October 10, 1876.) 8vo, pp. 10.

The Rocky Mountain Locust or Grasshopper. Being the Report of Proceedings of a Conference of the Governors of several Western States and Territories, together with several other Gentlemen, held at Omaha, Nebraska, on the 25th and 26th days of October, 1876, to consider the Locust Problem. 8vo, pp. 58.

Sopra Alcuni Opilioni (Phalangidea) d' Europa e dell' Asia Occidentale, con un quadro die Generi Europei, di Quest' Ordine. By Prof. T. Thorell. Genova. 1876. 8vo, pp. 57.

Enumerazione dei Rettili raccolti dal Dott. O. Beccari in Amboina, alle Isole Aru, ed alle Isole Kei, durante gli Anni 1872-73. By G. Doria. Genova. 1875. 8vo, pp. 33. Two Plates.

Elenco di una Collezione di Rettili raccolti a Bintenzorg (Giara) dal Signor G. B. Ferrari, ed inviati in dono al Museo Civico di Genova. By G. Doria. 8vo, pp. 6.

Diagnosi di Alcune nuove Specie di Coleotteri raccolte nella regione Austro-Malese dai Signori Dott. O. Beccari, L. M. d'Albertis, e A. A. Bruijn. By R. Gestro. 8vo, pp. 13.

Descrizione di una nuova Specie di Eupholus (Eupholus Bennettii n. sp.) By R. Gestro e L. M. d'Albertis. 8vo, pp. 3.

Note sopra Alcuni Carabici, appartenenti al Museo Civico di Genova, con Descrizioni di Specie nuove. By R. Gestro. 8vo, pp. 45. Illustrated.

Descrizione di un nuovo Genere e di Alcune nuove Specie di Coleotteri Papuani. By R. Gestro. 8vo, pp. 35.

Descrizione di Tre nuove Specie di Cicindelidi del l'Isola di Borneo. By R. Gestro. 8vo, pp. 4.

Descrizione di Tre Specie nuove del Genere Atractocerus appartenenti alle Collezioni Museo Civico di Genova. By R. Gestro. 8vo, pp. 4.

Osservazioni sopra Alcune Specie Italiane del Genere Cychrus. By R Gestro. 8vo, pp. 7.

Enumerazione dei Cetonidi, raccolti nell' Arcipelago Malese e nella Papuasia, dai Signori G. Doria, O. Beccari, e L. M. d'Albertis. By R. Gestro. 8vo, pp. 31. Appendix, pp. 28.

Note sopra Alcuni Coleotteri appartenenti alle Collezione del Museo Civico di Genova. By Dr. R. Gestro. 8vo, pp. 13.

Note sopra Alcuni Coleotteri appartenenti alle Collezione del Museo Civico di Genova. Nuova Specie del Genere Zanthe. By Dr. R. Gestro. 8vo, pp. 8.

GENERAL NOTES.

BOTANY.[1]

Fertilization of Gentiana Andrewsii. — Humble-bees are in the habit of entering bodily into the flower of this gentian, forcing open the mouth of the corolla to do so where this is closed, as it is in the absence of sunshine, and the anthers open before the stigmas separate to expose the pollen-receiving surface; so it is evident that cross-fertilization is provided for. Our correspondent, Mr. M. W. Vandenberg, of Fort Edward, N. Y., communicates the result of some observations which show that this flower has likewise an arrangement for self-fertilization. The short tube of cohering and extrorsely opening anthers is higher than the stigma when the blossom first opens. The pistil afterwards lengthens, so that its apex protrudes; the broad and introrse stigmas now separate, at first moderately, but at length they diverge strongly and become revolute, so as to bring a portion of the broad stigmatic surface into contact with the outer face of the anther tube, which usually is still covered with abundance of pollen. The pollen appears to retain its freshness for a long time, and in this slow movement of revolution of the stigmas they are seen to take up considerable masses of the moist pollen. Those stigmas, therefore, which have failed to receive extraneous pollen from bees during the first day or two of anthesis, will afterwards secure it from their own anthers. "Get fertilized, cross-fertilized if you can, self-fertilized if you must, is nature's golden rule for flowers." — A. Gray.

Origin of Varieties; Two Illustrations. — Eight or ten years ago, on a plot of ground where I had grown beet seed of the early turnip variety, after the crop had been gathered from the seed that had dropped on the ground, there sprang up thousands of young plants. A large proportion of these lived through the winter. It is my impression that they had the protection of a thick growth of chick-weed. In the following spring, when plowing, these plants were so forward I left a portion of the piece unplowed, with the view of obtaining a

[1] Conducted by Prof. G. L. Goodale.

crop of early beets. As the plants grew quite a number pushed seed shoots, and as the season advanced ripened a small crop of seed, which I saved in a mass, and the next season planted a portion of it. Here I will note, that all the beets from which the first crop of seed grew were of one variety, and being for seed purposes were very carefully selected at that time; and that the seed that was gathered from them in the autumn when planted the next season produced a crop pure and true to name; also, that the field in which the two crops of seed grew was in the middle of a great pasture, very isolated; and finally, that no other beet seed was raised there. Now, as to the result, the beets raised from this second crop of seed were, to use an expressive word, "everything," ranging all the way from a small, very dark-fleshed variety, through a score or more of kinds of various color, form, and texture, down to a light-fleshed, medium long variety of mangel-wurzel, which, as farmers know, is a very coarse-fleshed kind raised for the feeding of stock.

My other illustration is an experiment with Indian corn. With this I have had no personal experience, but a very intelligent correspondent writes me, that seeing occasionally the spindle of his corn (he was raising the Dutton variety) replaced by small ears, he was led from curiosity to save and plant the kernels of some of these. The result was, he obtained a vast number of entirely new varieties each having characteristics of its own. I wonder if other experimenters (we farmers, mind you, don't propose to leave all the experimenting with you men of science!) may not have something to put on record about — say the short-horn variety of carrot, which probably more than any other tends to push occasional seed shoots the first season? — J. J. H. Gregory.

Ipomœa setosa. — We succeeded in growing the rare plant, *Ipomœa setosa*, in Florida last year. The seed was found among some "Java" coffee and planted in rich soil. On the 17th of May, when we left Florida for the North, the plant was about six inches high. Upon our return, the first of November following, to our surprise the plant had completely covered a small live-oak. The main stem of the vine was about fifteen feet in length and six inches in circumference at the base, with numerous large branches radiating in all directions. Had the support been taller the plant would have climbed much higher; as it was, it clambered about in all directions, entirely covering the tree, the various subdivisions reaching the top of the tree and falling back to the ground, thus making more than thirty feet of length. The support was a living tree, but the great weight of the vine broke every branch, leaving the bare trunk standing.

Frost came the first of December, cutting it down while still a mass of bloom, and great clusters of unripe seed, fully enough to have made a peck of ripe seed, if frost had kept off as late as the year before. As it was, we did not save a pint of seed.

The flowers were large and of a bright pink color; leaves large and lobed, and the stems and peduncles covered with soft prickles.

I sent specimens of the foliage and unripe fruit to Professor Sargent, Director of the Botanic Garden of Harvard University, for identification. His reply is as follows: "Your morning-glory seems to be *Ipomœa setosa* Lindl., a little-known species; it occurs in Jamaica as an introduced plant from Brazil, while the flora of Brazil is doubtful of its nativity. At any rate you have a most interesting plant. If possible send good herbarium specimens of flowers and foliage, and by all means a good supply of ripe seed. You will do well to plant several seeds in order to secure a crop of seed for next year for general distribution, as there is no chance that seed will ripen here, either in the garden or under glass. This plant flowered in England as long ago as 1818, but is long since lost to cultivation. So you will be conferring a great benefit on cultivators by re-introducing it."

All the seeds that we can spare this year, we shall send to Professor Sargent for him to distribute as he thinks best.

The remarkable growth of the plant was in a great measure owing to the soil in which it grew. It was planted on a terrace adjoining the St. John's River. The terrace is made mostly from muck taken from the river. Some weeds grew here to the size of small trees. One amaranth attained the height of twenty-five feet and eighteen inches in circumference, and several others approximated this. — MARY TREAT.

OBJECTS OF THE DIVERSITIES IN THE MODE OF ARRANGEMENT OF THE FLORAL ORGANS. — In the paper by Dr. Masters, elsewhere referred to, occurs the following passage which will be of interest to our readers: "The alternate position seems to be in most instances a provision for ensuring space to closely packed organs, so as to prevent undue amount of pressure on the growing tissues. In cases where the development of the stamens lags behind that of the petals, the question of space is not of so much moment as under other circumstances. It may often be an advantage to the plant to have the stamen concealed in the cavity of the petal, ... where such an arrangement may be beneficial either for protection's sake, or in various manners connected with fertilization. In other cases the existing arrangement may be a relic of some ancestral condition which has now lost its significance; or, on the other hand, could we but read it aright, it might offer a forecast of some future development."

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Journal of the Linnæan Society, Botany.* December 15th. T. H. Potts, Habits of Filices observed about the Malvern Hills, Canterbury, New Zealand. S. H. Vines, On the Digestive Ferment of Nepenthes. (The following facts are regarded by the author as established by his experiments: (1.) The glands of the pitchers of Nepenthes contain a digestive ferment which is soluble in glycerine, and which can exert its digestive action only in the presence of acid. The fact of digestion was clearly made out by Von Gorup-Besanez, May 22, 1876; (2.) the digestive fer-

ment exists at first in the gland-cells of the pitchers, in combination with some other body, as zymogen, and this zymogen is split up by the action of dilute acid, the free ferment making its appearance as the result of this decomposition. The author further states, that the experiments run perfectly parallel with those of Ebstein and Grützner on the stomach, and with those of Heidenhain on the pancreas.) J. M. Crombie, An Enumeration of Lichens from Rodriguez Island. (Twenty-five new species are described.) W. Archer, On Fresh-Water Algæ from Kerguelen's Land. (According to the author, who found nothing new in the collection, the algal flora of this remote and isolated spot is not unlike that of England. Mr. Reinsch described early in this year three new genera and thirty new species from this region.) Professor Dickie, Algæ from the Coasts of Japan, and from Juan Fernandez. Dr. Masters, On the Superposed Arrangement of the Parts of the Flower. (An attempt to explain anteposition by referring special cases to the following causes: (1.) Superposition of whorls. (2.) Spiral arrangement of parts, the calyx forming a complete cycle, followed by the corolla in like manner. (3.) Enation, or outgrowth, and chorisis, or division. (4.) Abortion, the most common cause. (5.) Multiplication of parts. (6.) Interposition. (7.) Substitution of one organ by another. (8.) Torsion of the axis.)

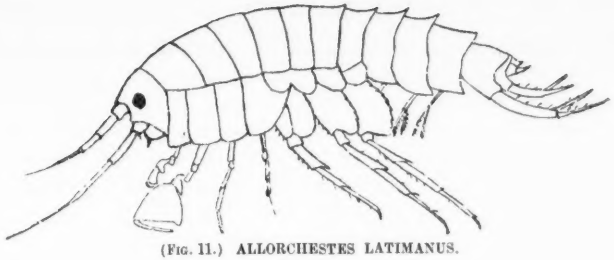
Flora, No. 3. Westermaier, The First Cell Division in the Embryo of Capsella Bursa-Pastoris. Nylander, On New Cuban Lichens (Species of Lecanora).

Botanische Zeitung, Nos. 43 and 44 not yet at hand. No. 45. Kienitz-Gerloff, On the Genetic Connection of Mosses with Vascular Cryptogams and Manerogams. (Continued in No. 46.)

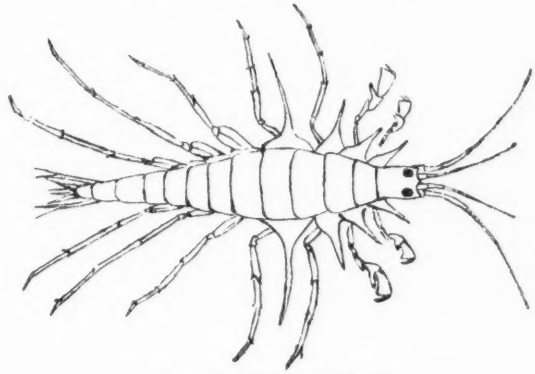
ZOÖLOGY.

The Crustacea of Lake Titicaca. — In the Naturalist (x., 380) we have called attention to the exploration of Lake Titicaca, by Messrs. Agassiz and Garman, and alluded to the marine nature of the crustacean fauna of this lake. Since then Mr. W. Faxon has published, in the Bulletin of the Museum of Comparative Zoölogy, descriptions and figures of the crustacea of the lake. "Excepting," he remarks, "a species of *Cypris*, all the specimens collected belong to one amphipodous genus, *Allorchestes*, which had hitherto afforded but one or two authentic fresh-water species, ranging from Maine to Oregon and the Straits of Magellan. Seven new species are described in this paper from Lake Titicaca. Several of them are remarkable among the *Orchestidæ* for their abnormally developed epimeral and tergal spines. Some are also noteworthy as comparatively deep-water forms of a family commonly regarded as preëminently littoral. I believe that no *Orchestidæ* have heretofore been found at a depth so great as sixty-six fathoms,[1] unless it be *Orchestia* (*Talitrus*) *Brasiliensis* Dana, and *Nicea media* Dana,

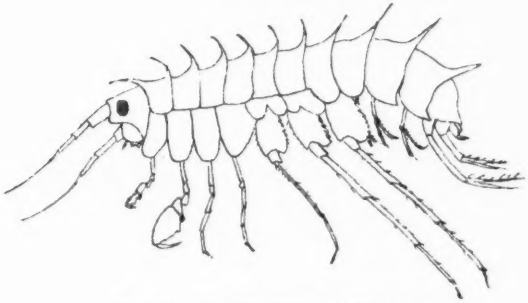
[1] The greatest depth of the lake is 154 fathoms.



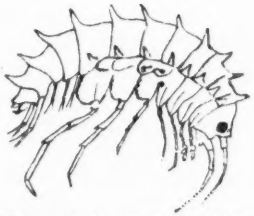
(Fig. 11.) ALLORCHESTES LATIMANUS.



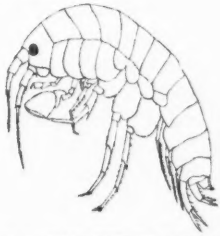
(Fig. 12.) ALLORCHESTES ARMATUS.



(Fig. 13.) ALLORCHESTES LUCIFUGAX.



(Fig. 14.) ALLORCHESTES ECHINUS.



(Fig. 15.) ALLORCHESTES DENTATUS.
Var. inermis.

dredged in the harbor of Rio Janeiro (at what depth is not specified) by the Wilkes Exploring Expedition. The marine species usually inhabit the shores above low-water mark, and the previously described fresh-water species are found in the shallow water of brooks, pools, or edges of lakes." To give some idea of the different forms of these crustacea we have inserted a portion of the figures prepared by Mr. Faxon and kindly loaned by Mr. Agassiz.

ANTHROPOLOGY.

More Cordate Ornaments. — Since my note on this subject in the January Naturalist has been placed in the hands of the printer, two more cordate ornaments have been brought to my notice. One is in the collection of J. H. Jenkins, having been found in a mound in Warren County, Ohio, lying on the neck of a corpse. It is made of a hard stone, flat on both sides and measures about four and a half inches in length, three and a half across the broadest portion of the lobes, and half an inch in thickness, the edges being cut squarely and the notch deeply.

The second specimen is now in the possession of Mr. William S. Vaux, of Philadelphia, and is somewhat similar. A sufficient number of these objects, therefore, have been thus far discovered to establish the type, which, so far as I know, is a new one, and all doubt is removed as to its aboriginal origin. — E. A. Barber.

Anthropological News. — *Nature* for October 26th contains an abstract of a paper on Cave-Hunting, read before the Philosophical Institute of Canterbury, N. Z. The paper describes the inspection of the Moa-Bone Point Cave, on the east side of the middle island, in Banks' Peninsula. From the results of the excavations, Dr. Haast infers that a very long time has elapsed since the extinction of the moas in that part of the island.

A recent census in the schools of Prussia showed that out of 4,127,766 persons examined, 4,070,923 were under fourteen years of age 42.97 per cent. had blue eyes, 24.31 per cent. brown eyes; 72 per cent. had blonde hair, 26 per cent. had brown hair, and 1.21 per cent. had black hair; 6.53 per cent. were brunettes.

During the coming winter, free lectures on anthropology will be given in Paris, at the École libre d'Anthropologie, by MM. Broca, Topinard, Dally, Mortillet, and Hovelacque. The following gentlemen in Paris have signed a paper, binding each one to make a will, directing that upon his decease his brain shall be sent to the Anthropological Society for inspection: MM. Hovelacque, Dally, Mortillet, Broca, and Topinard. The motive of this singular pledge is to afford facilities for inspecting the brains of men whose special mental pursuits are definitely known, in order to see whether there is any connection between the structure and aspect of that organ and its well-known operations.

In the *Academy* for September 30th, October 21st, and 28th, is an interesting discussion between the Rev. Moncure D. Conway and Mr.

Frederick Poynder; the former strenuously maintaining "that all those pictures of Hindoos casting themselves beneath the Juggernaut car, to be crushed, were purely imaginary." In his latest communication Mr. Conway endeavors to prove that Mr. Claudius Buchanan and the Abbé Dubois were not competent observers.

In acknowledging, at the French Association, the labors of M. Tubino on the populations of the Iberian peninsula, M. Broca says there is a true anthropological similarity between the Spanish peninsula and the north of Africa, and indeed the Canary Islands. I will go further and insist upon the analogy which I have already remarked between the Cro-Magnon race and the Guanches of Teneriffe. I believe that at an epoch anterior to the rupture of the Straits of Gibraltar, a stratum of population extended from Perigord, at least, on the north, to Africa and the Canaries on the south. I have always been struck with the similarity between the Spanish Basque and the Berber skulls. In the caverns near Gibraltar, which date back certainly to the polished-stone age, crania were found, the similitude of which to Basque skulls struck Mr. Busk as well as myself.

In *Matériaux*, No. 9, L. Pigorini publishes a list of the provinces in Italy wherein bronze objects are found, and of the particular kinds which are found in each province. The presence of knives, celts, fibulæ, spear-heads, etc., show us that "the men of the bronze age in the peninsula had the same manners and customs as those of the same age in France. — O. T. Mason.

Antiquities near Naples. — During a summer spent in the neighborhood of Naples, I had the pleasure of examining some objects, evidently prehistoric, and of visiting the locality in which they were found, the cemetery of the Piano of Sorrento, formerly called *Casa Talamo*. In the excavation of a long ditch, made, according to the prevailing Italian custom, for the interment of the poor, at a depth of more than six feet, was found hollowed in the *tufa* a cavern, cut smooth, the floor as well as the arch, more than a yard in height, two in width, and two in length. Within it were several objects of great antiquity. Among these were three articles of the simplest form of pottery. One was a vase of terra cotta, with a handle, the largest circumference being ornamented by perpendicular lines, inclosing spaces, every other one of which was lightly and lineally punctured. The height of this vase was about twenty-nine centimetres, and its largest circumference eighty-three.

Another vase was of unbaked earth, without any ornamentation or handle, and broken upon one side. Its height was about twenty-seven centimetres, and its largest circumference seventy-eight. There was also a little cup, of very primitive terra cotta, without ornament, the handle broken off. The objects in flint were six or seven small arrow-points, quite delicately cut. There was an instrument of sandstone, roughly cut, diminishing to a blunt point. Its length was twenty-one centimetres, and

its diameter three. The only entire object in metal was a poniard, the layers of the blade peeling off and broken. It measured thirty-five centimetres in length. There was a point of another.

Lastly, there was a human bone completing the contents of the cavern, which is now no longer accessible, the ditch having been filled with dead and closed. The objects, however, are carefully preserved in the municipal building of the Piano. — CLARA L. WELLS, Rome, October 19, 1876.

GEOLOGY AND PALÆONTOLOGY.

NEWBERRY'S GEOLOGY OF PARTS OF NEW MEXICO AND UTAH.[1] — Although much of the region surveyed by Professor Newberry in 1859 has been reëxamined by later explorers, yet geologists will be interested in this account of the independent observations of so distinguished an observer, while the traveler and explorer will be attracted by the fine colored views of the more striking points in the scenery of the route surveyed. The report is divided into seven chapters, and is accompanied by eleven chromo-lithograph plates of views taken in Northwestern New Mexico, Southwestern Colorado, and Southeastern Utah. Eight plates accompanying the palæontological descriptions of Mr. Meek and Professor Newberry illustrate the fossil shells and plants. Archæologists will be interested in the account on page 41 of the ancient mines of turquois, or *chalchuitl*, situated in Los Cerillos Range in New Mexico, as well as in the views and account of the ancient ruins of the San Juan Valley, which this party was one of the first to visit.

GEOGRAPHY AND EXPLORATION.

WARREN'S IMPROVEMENTS OF THE FOX AND WISCONSIN RIVERS.[2] — In a report of over one hundred pages, illustrated by ten maps and plates, Gen. G. K. Warren, who has long been connected with Western and Eastern river improvements, and in so doing has always had an eye to the scientific relations of the subject before him, gives a historical sketch of the discovery of the route of these two rivers, with plans for their improvement by a canal. By the maps and scattered observations the report is rendered one of much general geological and geographical interest.

SIMPSON'S EXPLORATIONS ACROSS THE GREAT BASIN OF UTAH. — To those interested in Western geography this volume (which has been in MS. since 1860) will have an especial interest. Not only is it valu-

[1] *Report of the Exploring Expedition from Santa Fé, New Mexico, to the Junction of the Grand and Green Rivers of the Great Colorado of the West, in* 1859, *under the Command of Capt.* (*now Col.*) *J. N. Macomb, U. S. Engineers.* With Geological Report by Prof. J. S. NEWBERRY. Washington, D. C. 1876. 4to, pp. 148. With maps and plates.

[2] *Report of Explorations across the Great Basin of the Territory of Utah, for a Direct Wagon Route from Camp Floyd to Genoa, in Carson Valley, in* 1859. By Capt. (now Col.) J. H. SIMPSON, U. S. Engineers. Washington. 1876. 4to, pp. 495. Maps and 17 plates.

able from the large mass of unpublished facts regarding the region traversed, but from the historical *résumé* of explorations made in the Great Basin from 1776 until 1869, given by Colonel Simpson, and from the abstracts and quotations from Father Escalanti's MS. journal, now said to be treasured up in the city of Mexico, and of which a copy was contained in the library of Col. Peter Force, of Washington. Besides the itinerary by Colonel Simpson, and several appendices giving the astronomical, meteorological, and geographical results of the expedition, there are valuable reports on the geology, palæontology, natural history, and ethnology chiefly of Utah, including elaborate treatises on the ichthyology by Professor Gill, and on the botany of the route by Dr. Engelmann, both of which are accompanied by numerous plates.

Recent Changes of Level of the Great Salt Lake. — The party which started about seven days ago under Captain D. L. Davis to explore the western shore of the Great Salt Lake returned last evening after a successful trip. Starting from near Farmington, the party touched at Church Island and then sailed direct to Strong's Point, where the old triangular monument, erected by Stansbury, was found intact. The lake was found to have risen so that many miles marked as lake shore on the maps is now from six to ten feet under water. The Water Witch sailed "inland" for about twelve miles, when the occupants waded ashore and took observations, but it was found that there is a general elevation of the land, which, though slight, precludes the possible lowering of the lake in this direction. The party then beat along the shores northward as far as Kelton, landing frequently to make observations and take angles. It was found, however, that the shifting of the lake westward was an impossibility. Touching at Fremont Island, the company returned with the problem answered, but not satisfactorily. — *Salt Lake Times*, September 14, 1876.

MICROSCOPY.[1]

Cleaning Diatoms with Glycerine. — Mr. James Neil, of Cleveland, uses glycerine as an easy and efficacious means of separating diatom shells from the foreign matter with which they are naturally mixed. He fills a two-ounce graduated measuring glass three quarters full of glycerine and water mixed in equal parts. The diatoms after being treated with acid and thoroughly washed, are then shaken up in some pure water and poured gently over the diluted glycerine. If carefully done the water and diatoms do not at first sink into the glycerine, but gradually the diatoms sink through the water, and into the glycerine, preceding the light flocculent matter held in the water. After a few minutes, a pipe introduced closed through the water and into the glycerine will bring up remarkably clean diatoms, which are to be afterward freed from glycerine by repeated washing and decanting. Coloring the water in which the diatoms are held is thought to aid in watching

[1] Conducted by Dr. R. H. Ward, Troy, N. Y.

the progress of the operation. This method has been tried thus far on Richmond earth, in which the diatoms are heavier than the adherent matter, but it is believed to be generally applicable.

CUPRO SCHEELITE. — This new mineral which occurs in different parts of California, and which resembles scheelite in which a part of the lime is replaced by oxide of copper, was first described and named by Professor Whitney. Mr. Hawks, in describing it to the San Francisco Microscopical Society, stated that when first discovered it was thought to be a mechanical mixture of scheelite with some copper mineral, but that a careful examination under the microscope showed it to be perfectly homogeneous. The decision of the microscope was subsequently confirmed by the discovery of crystals of the mineral, which proved it to be a distinct and new species.

SCIENTIFIC NEWS.

— On the 28th of December, 1876, died at the Smithsonian Institution, in the fifty-ninth year of his age, F. B. Meek, long connected with the Institution as a volunteer assistant in the department of palæontology.

Mr. Meek was of Irish extraction, his parents having settled in Indiana some sixty years ago, and shortly after his birth removed to Kentucky, where young Meek received a common school education, and was known when quite young for his ability as a writer, his retiring disposition, and for exhibiting a marked interest in geology and kindred branches of science. On arriving at his majority he entered into commercial pursuits in which he was not successful, and afterward for a time earned his daily bread as a painter of portraits and such other subjects as the necessities of his surroundings offered to him. He was also connected for a time with some local museum of curiosities of the old-fashioned kind. At a later date his geological predilections were favored by a connection with some of the earlier geological surveys in the West, while his scientific career may be said to have fairly been opened by his employment as a draughtsman and assistant on the survey of the State of New York. The discovery which first brought him into prominence was his identification, independently, of Peruvian rocks in America, a fact which was discovered nearly simultaneously by several better-known geologists. His undivided attention to palæontology and his almost unrivaled abilities in delineating the fossils which he studied, joined to great caution and what appeared to be an intuitive capacity for recognizing the relations of the remains he described, soon placed him in the front rank of American palæontologists. The progress of geological discovery in the West, which has culminated at the present day in the great surveys of Hayden, Powell, and Wheeler, under government auspices, is in large part due to the abilities of Mr. Meek, for without

such able coöperation the fossils of the different strata, of which by far the greater proportion were determined by him, would have failed to yield a moiety of the material for generalization upon which American geology has been built up. Among numerous publications on American palæontology by the deceased may be mentioned the Invertebrate Palæontology of Illinois, Ohio, part of California, in the Geological Survey Reports of these States; an Early Report on the Palæontology of the Upper Missouri, published by the Smithsonian Institution; on the Palæontology of the Explorations under Simpson, Macomb, King, and other Government Surveys and lastly the great work of his life, the Palæontology of the Upper Missouri, just issued by Dr. Hayden in the quarto series of the publications of the Geological Survey of the Territories. In all these volumes the palæontological work was strictly his own, though his name was for sufficient reasons associated with that of the geologist to whom the collections were due or under whose direction the publications were issued.

Mr. Meek left no kindred so far as is known. His habits were most simple and regular, abstinent to a remarkable degree, and he shrank from society, except that of a scientific character or of a few old and valued friends. This retiring disposition was encouraged by the infirmity of total deafness by which he was afflicted during later years and which he bore with the utmost patience. Only a few intimates could know of his cheerful, helpful spirit, his love of children and animals, his transparent honesty and probity, and the generosity which led him to render assistance to the beginner or the practiced geologist whenever his help was requested. His death resulted from the weakness consequent on pulmonary hæmorrhage from which he had suffered for some years. His illness was painless and of short duration, and his remains were carried from the geological hall of the Institution he had served so long to the Congressional Cemetery in Washington, by a small but appreciative assemblage of his associates and friends. — W. H. Dall.

— The Summer School of Biology at the Peabody Academy of Science, Salem, Mass., met with such a good measure of success last year that it will be a permanent feature of the work done at the Academy. Though the school was limited to fifteen, more than this number were present. Over forty lectures were delivered. The laboratory work done was in some cases excellent. The school is designed to give laboratory facilities to naturalists and teachers residing in inland towns who may like to spend their summer vacations in collecting and studying marine life at the seaside.

— Professor Valerien de Moeller, of the Imperial School of Mines, St. Petersburg, Russia, is preparing a monograph of the *Fusulerias*, and desires any information on the subject that he can obtain from American palæontologists.

— Prof. L. de Koninck, the veteran palæontologist, of Liége, Belgium,

has commenced his great work on the Carboniferous fossils of Belgium, to contain 150 plates, 4to. After forty-five years of service the Belgian government has conferred upon him a pension, which will enable him to spend the remainder of his life in comparative independence.

— The Congrès International des Américanistes will hold its second session at Luxembourg, September 10–13, 1877. The secretary, Mr. J. Schoetter, is very anxious that communications be sent at as early a date as practicable from Americans. He hopes that American savants will be induced to take as large a part as possible in this meeting, and that they will furnish matter enough for one volume of the *Comptes rendus*.

— Karl Ernst von Baer, the eminent zoölogist and embryologist, died at St. Petersburg, November 29, 1876, aged eighty-five years. He will always be remembered for his classic work, Ueber Entwickelungsgeschichte der Thiere, 1828–37. In 1834 he resigned his chair of zoölogy at Königsberg and removed to St. Petersburg, becoming librarian of the Academy of Sciences. — Theodor von Heuglin, the traveler and zoölogist, died at Stuttgart, November 5th, aged fifty-two years. — A well-known Scotch zoölogist, Dr. T. Strethill Wright, died October last, aged fifty-eight.

— In order to furnish an opportunity for teachers in natural science and special students in geology to become acquainted with the methods of practical work in that science, a Summer School of Geology will be conducted by Prof. N. S. Shaler and Mr. Wm. M. Davis, Jr., assistant in geology, during six weeks in July and August, under the form of instruction at Cambridge and an excursion through Massachusetts and into New York. The school will open early in July at the Museum of Comparative Zoölogy, in Cambridge. A fortnight will be spent in introductory work, and in short, daily excursions. The rest of the time will be divided between the Connecticut Valley, the Berkshire Hills (Western Massachusetts), and either the Helderberg or the Catskill Mountains of New York. In each locality some central point, characteristic of the district and easily accessible by railroad, will be taken for headquarters, and short excursions on foot or by rail will be made from it. Persons wishing to join the school should address Wm. M. Davis, Jr., 15 Summer St., Cambridge, Mass.

— Professor Henry urges the establishment of a national museum at Washington, with the government Centennial collection as a nucleus, and the repaid Centennial loan as a building and endowment fund.

PROCEEDINGS OF SOCIETIES.

New York Academy of Sciences. — *Biological Section*, October 2d. Captain J. H. Mortimer exhibited a series of pelagic animals, such as pteropods, Carinaria, Atlanta, Janthina, small cephalopods, crustacea, and the insect *Halobatis*, together with Salpa, Physalia, Porpita, Vellela,

etc., collected by him in the course of a voyage from New York to San Francisco, and back by way of Liverpool.

Geological Section, October 16th. A paper on Prehistoric Remains in Western North Carolina was read by Mr. A. A. Julien, who has been associated with Professor Kerr in the survey of that State. Four classes of such remains were considered, namely, tools, rude sculpturings, mounds, and excavations. A small collection of tools was exhibited, and accidental resemblances to those from St. Acheul, France, noted in them. The rude imitative carvings on rocks, which have been observed in two localities, were then referred to, as well as those, possibly of Indian origin, on beeches in the Nantehaleh Valley, resembling maps of the surrounding excavations. The scarcity of mounds was explained, their general restriction to the tract covered by ancient excavations referred to, and a description given of the largest one, near Franklin, Macon County.

A remarkable pitting of the mountain sides by mines is now going on; but perhaps it hardly equals that which formerly existed, as represented by the extensive series of ancient excavations which extends from Mitchell County southward to the state line, and into Georgia, and which seems to have been directed to the exploitation of two minerals, muscovite and steatite. The peculiar industry of the region at present consists in mining for mica. The coarse granite veins which contain it often include a central quartz band, which has affected the character of both the prehistoric and the present styles of mining. All the mines are superficial, and their veins may be divided into hard or soft, in relation to the state of decomposition of their materials. In fourteen mines visited, in which the veins are hard, no ancient workings had been found. But of twenty-one mines with soft veins visited, eight had been discovered through the ancient workings, whose size was proportioned to that of the veins, and generally indicated their importance for the present industry. These workings are of two classes. The one consists of deep shafts, sometimes containing iron tools, and supposed by some to be due to the Spaniards, or to later adventurers in the early history of our country. The other class consists of open excavations, sometimes connected with small tunnels, and are certainly of prehistoric origin. These were severally described, namely, the Sink Hole and Buckhannon mines in Mitchell County; the Gibbs in Yancy County; Allman's, Raby's, Hall's, and Smith's in Macon County; and Smith's in Clay County, with observations on the mode of mining, the form of the tunnels, the character of the dumps, the plans and sections of the excavations, and the tools probably used by the ancient miners. The ashes discovered in certain mines may betoken the occasional use of fire in the course of mining here, as in the tunnels of the Lake Superior copper region.

The vast quantities of mica which have been extracted in this region

in prehistoric times were then considered, and their probable destination. Lastly, a description was given of the similar, but less extensive, series of excavations for steatite in the counties of Clay, Swain, etc. The importance of a careful topographical survey of this portion of the State should be impressed upon its people and their legislators; but unless it speedily takes place the progress of agriculture and the absence of public interest will soon destroy many of these interesting monuments of its ancient history.

The paper of Mr. Julien was discussed with much interest. Dr. Newberry and Professor Martin referred particularly to the extensive use of mica plates in the tombs of the mound-builders in the Mississippi Valley, as described by Dr. Rau in his essay on aboriginal trade in North America. It is evident that in these mines we have the source of this mica, which had until recently been a problem with archæologists.

Prof. Thomas Egleston read a paper upon Vein Accidents in the Lake Superior Region; its character was such, however, that it is difficult to present it without the diagrams which accompanied it.

The Biological Section held a special meeting on October 30th, at the library of the New York Aquarium. The chairman of the section, Prof. E. C. H. Day, gave an opening address entitled Thoughts on Evolution, in which he opposed a good many objections that are raised against the evolution hypothesis, and pointed out their weakness. President Newberry followed, in a somewhat different view, holding that many of these objections are yet unanswered. Mr. Frederick Mather, of the aquarium, then described and illustrated quite fully the operations now going on there in the hatching of the California salmon, with which it is proposed to stock the Hudson River.

Section of Geology and Mineralogy, November 20th. Papers on the Smelting of Native Copper at Lake Superior, by Prof. T. Egleston; on New American Fossil Fishes, by Prof. J. S. Newberry; and on the Lower Helderberg Rocks at Port Jervis, N. Y., by Dr. S. T. Barrett, were read.

Philosophical Society of Washington. — November 18, 1876. Dr. E. Bessels spoke of the English Polar Expedition, calling attention to the fact that the season they experienced was an evidently abnormal one, as compared with the experiences of all other observers; and that while it was doubtless true that under the circumstances no great progress toward the pole was possible, yet the obstacles encountered by these energetic explorers were by no means proved to be permanent, or insuperable in more favorable seasons.

He called attention to the confirmation by the English of the observations made by him during the Polaris expedition, showing that the tides in the northern part of the channel come from the north; not (as he had at one time supposed) from the Pacific, but from the North Atlantic around the north coast of Greenland.

Mr. Dall remarked that the difference in character of the tides in the West Arctic basin, in Bering Sea, and in the North Pacific south of Bering Sea was such as almost to render certain the fact that the basin of the Polar Sea west of the Parry Islands has a tide of its own, which, according to Haughton (On Tides at Point Barrow), is a simple semi-diurnal wave, totally different from those observed by the United States Coast Survey in the other localities mentioned. He indorsed Dr. Bessels' view that the northern tides of Polaris Bay were in all probability derived from the North Atlantic.

December 2, 1876. Colonel Mallory, United States Army, exhibited a painted cloth which was obtained from a Sioux Indian, and which was a second copy from the original, said to have been prepared by Lone Dog, a Sioux, who was stated to be the official chronicler of the Sioux tribes of the Northwest. This cloth contained a series of symbols placed in sequence so as to form a spiral beginning at the middle of the cloth and extending from left to right. These symbols were seventy-one in number, and were said to form a chronology of events, one for each year, beginning with the year 1801 and including 1871. The events were not of an important character in all cases, but were such as were probably specially notorious at the time of occurrence, therefore easily remembered and suitable for forming such a chronology. They did not relate solely to the chronicler's own tribe, but to the Sioux tribes in general. The events were frequently of an apparently trivial character, such as a particular murder or successful theft of horses, fight with the Crows, or building of a trading post; sometimes of more importance, such as an eclipse of the sun, the prevalence of a pestilence, the appearance of the first soldiers, etc. Colonel Mallory explained the asserted meaning of the symbols as obtained from a large number of Sioux of different tribes, independently, at different times and places, all of whom were said to recognize the chronological character of the inscription and the meaning of part of the symbols, though none were able to explain all of the latter. Yet by the explanations of different persons, most of the signs were explained. All were agreed as to the authorship and nature of the chronology, and their explanations were not paid for, hence a strong probability of the authenticity of the chronology and of its really chronological character.

Much discussion followed on the reading of the paper. It was pointed out by Major Powell and others that while the figures were many of them unmistakably Indian in their character, yet the commencement of the record with the century, the representation of an eclipse as a black sun instead of by the mythological symbols, the representation of individuals by symbols drawn from the literal meaning of their names instead of by their totemic symbols, were not aboriginal characteristics, and tended to throw a doubt on the purely Indian character of the author or inspirer of the record, which nevertheless possessed great inter-

est. The general verdict appeared to be that further confirmation of the character and original authorship of the asserted chronology was much to be desired.

Boston Society of Natural History. — November 1st. Prof. A. Hyatt made a communication on sponges, discussing their mode of development, based on original observations, and expressing his opinion that they formed the type of a new sub-kingdom of animals. Mr. J. A. Allen remarked on the American beavers, recent and fossil.

November 15th. Two papers were read by C. S. Minot entitled Classification of some of the Lower Worms; Description of a New Microtome for Cutting a Series of Sections.

December 6th. Prof. W. G. Farlow gave an account of certain algæ belonging to the groups *Oscillatoria* and *Bacteria*.

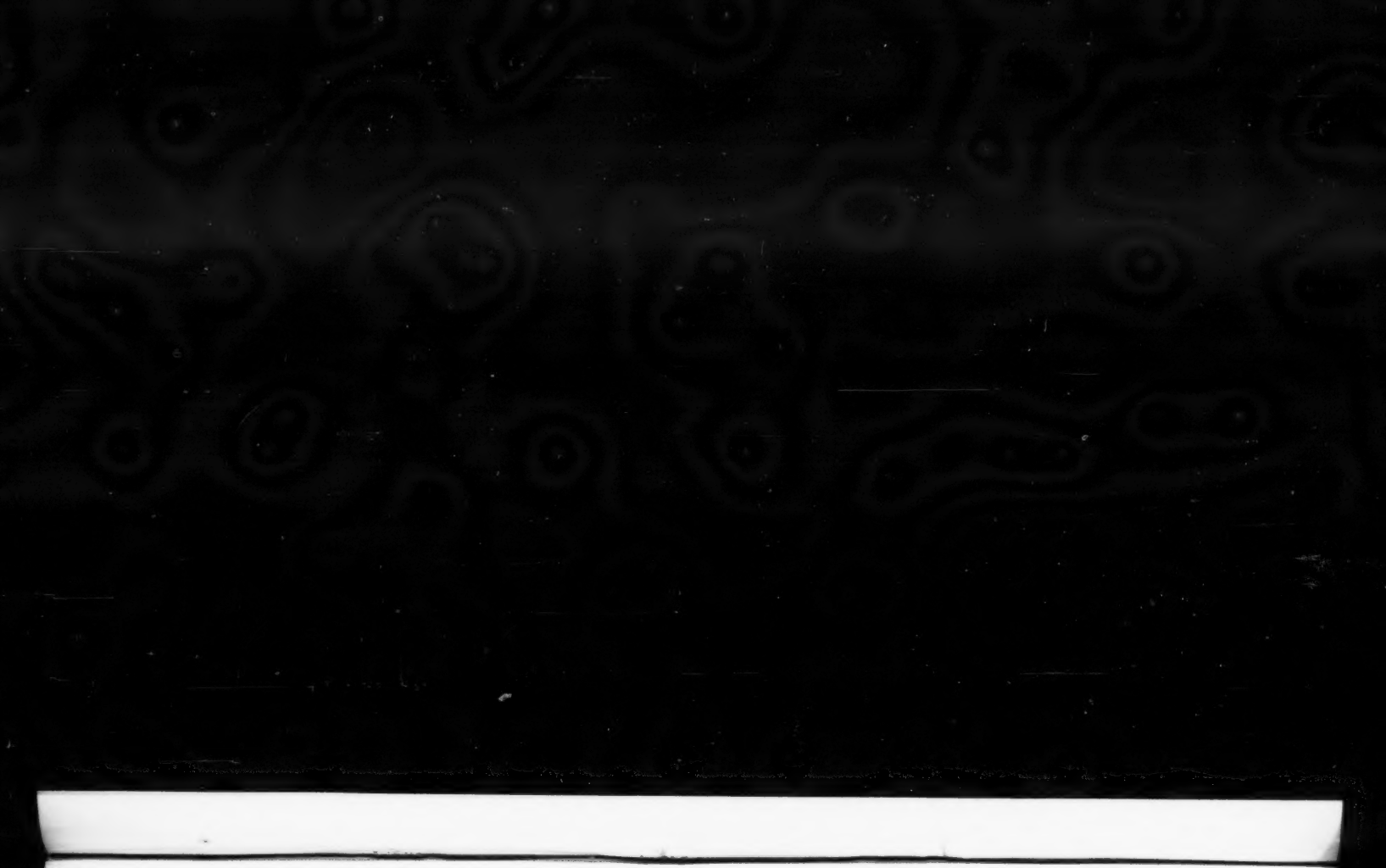
December 20th. Prof. C. H. Hitchcock and Rev. G. F. Wright spoke on ancient glacial moraines in Andover, Mass., and vicinity.

SCIENTIFIC SERIALS.[1]

Petermann's Geographischer Mittheilungen. — October 28th. Die neuen administrativen Eintheilungen Japans, von L. Metschnikoff. Bilder aus dem hohen Norden, von K. Weyprecht. Lieut. Wheeler's Expedition durch das südliche Californien im Jahre 1875, von O. Loew. Die Temperatur-Verhältnisse im Meere zwischen Norwegen, Schottland, Island, und Spitzbergen, von H. Mohn. October 9th. Die Insel Hawaii und ihre Vulkane, von F. Birgham. Die geographische Verbreitung des Hagels, von H. Fritz. Die jüngsten Forschungen im See-'ngebiet des äquatorialen Ost-Afrika, von Young, Gessi, Stanley, 1874–76. Reisen in Columbien im 1872.

Archiv für Naturgeschichte. — 42. Heft ii. Ueber einige Canis-Arten des südlichen Südamerika's, von H. Burmeister. Ueber die Nahrung der *Alausa vulgaris*, und die Spermatophore von *Temora velox* Lilj., von Max Weber. Die Familie der Bdelliden, von Dr. Kramer. Die Hautdecker und Schale der Gastropoden, von F. Leydig. Heft iii. Anatomisches und histiologisches ueber Gibocellum, eine neue Arachnide, von A. Stecker.

The Geographical Magazine. — December. Hissar and Kulab (Turkistan). The Indian Surveys, 1873–75.

The Geological Magazine — December. On the Glauconite Granules of the Cambridge Green Sand, by W. J. Sollas. On Fossils from the Glacial Deposits of the Island of Lewis, by R. Etheridge. Fossiliferous Pliocene Clays overlying Basalt in Lough Neagh, by E. T. Hardman.

[1] The articles enumerated under this head will be for the most part selected.